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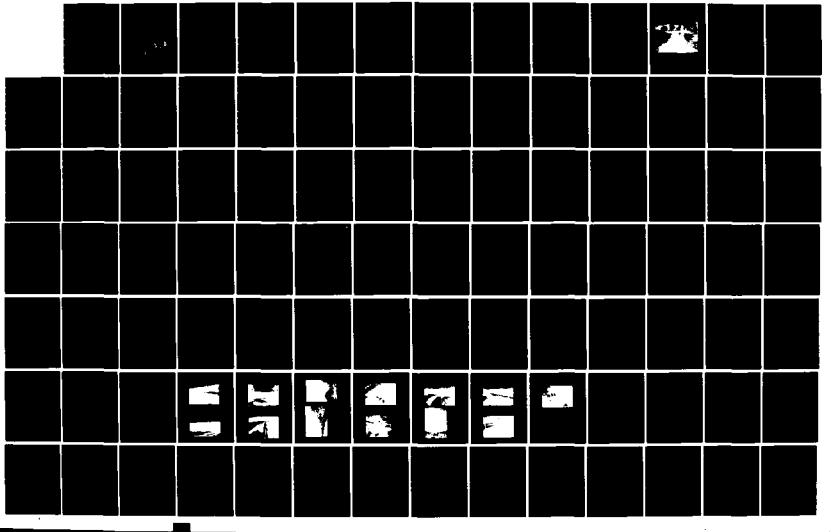

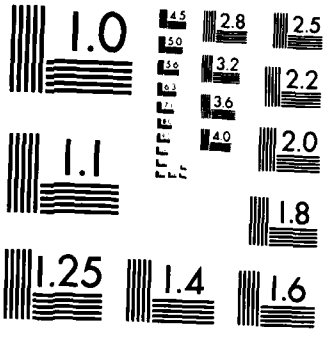

BLACKSTONE RIVER BASIN
DOUGLAS, MASSACHUSETTS

WHITIN RESERVOIR DAM

MA. 00200

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Blackstone River Basin
Douglas, Massachusetts

Unnamed Tributary to Mumford River

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Within the Reservoir dam is an ashlar faced stone wall dam with an upstream earth embankment. TXe dam is about 473 ft. long and 33. ft. high. The dam is classified as intermediate in size and high in hazard potential. The dam is judged to be in generally good physical condition. However, because of the inadequate spillway discharge capacity, it is rated as in fair condition.

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WHITIN RESERVOIR DAM

MA 00200

BLACKSTONE RIVER BASIN
DOUGLAS, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	MA 00200
Name of Dam:	Whitin Reservoir Dam
Town:	Douglas
County and State:	Worcester County, Massachusetts
Stream:	Unnamed Tributary to Mumford River
Date of Inspection:	15 April and 20 May 1980

BRIEF ASSESSMENT

Whitin Reservoir Dam is an ashlar faced stone wall dam with an upstream earth embankment constructed in the mid-1800's to supply the water needs of mills located downstream on the Mumford River. The facility is still used by the mills as a supply of process water. The reservoir is also used for recreational purposes. The dam is about 473 ft. long and 33 ft. high. Its horizontal alignment is of a gentle "S" configuration and Northwest Main Street is located along the entire length of the dam crest. The facility has two spillways: a relatively new concrete main spillway which is 27.5 ft. long and an auxiliary spillway constructed of heavy stone blocks which is about 25 ft. long. The two spillways are side by side and are located on the right side of the dam. There is a 2 ft. square stone box conduit passing through the dam near its midpoint which serves as a low level outlet.

The reservoir is about 10,000 ft. long and the surface area of the reservoir at spillway crest level is about 315 acres. The drainage area above the dam is about 8.93 sq. mi. (5,716 acres), the maximum storage to top of dam is about 4,475 acre-ft. Based on storage, the size classification is intermediate. A breach of the dam would damage about seven houses, two industrial buildings, two commercial buildings, a Mobil Oil Co. pipeline and several local roadways and potentially could cause the loss of more than a few lives; therefore, the dam has been classified as having a high hazard potential. Based upon the guidelines, the recommended test flood is a full PMF. The test flood inflow was calculated to be 13,540 cfs.

The routed test flood outflow of 9,000 cfs would overtop the dam by about 4.1 ft. The spillway can pass about 850 cfs or about 9 percent of the routed test flood outflow without overtopping the dam.

The dam is judged to be in generally good physical condition. However, because of the inadequate spillway discharge capacity, it is rated as in fair condition. Seepage was noted at two locations at the toe of the downstream stone wall. A stone parapet located on the upstream edge of the crest of the dam is in need of minor repair and the right training wall of the main spillway is in need of repointing. There is some vegetation growth and silt in the approach channel to the spillways.

Within one year after receipt of this Phase I Inspection Report, the owner, the Mumford River Reservoir Association, should retain the services of a qualified registered professional engineer and implement the results of his evaluation of a detailed hydrologic-hydraulic investigation to assess further the potential for overtopping and the adequacy of the spillways and their approach channel.

The owner should also implement the following operating and maintenance measures: (1) repair voids in the upstream parapet wall at a point about 20 ft. left of the low level outlet: (2) repoint the masonry rubble portion of the right training wall of the main spillway; (3) remove weeds and siltation in the approach channel downstream of the four 36 in. dia. pipe culverts; (4) monitor seepage at the toe of the downstream face of the stone wall to the left of the outlet structure on a six month basis to ascertain any changes in clarity or quantity of flow; (5) develop a formal surveillance and downstream emergency warning plan including round-the-clock monitoring during periods of heavy precipitation; (6) clean and repaint the footbridge; (7) continue to conduct annual technical inspections of the dam and its appurtenant structures; and, (8) implement a regular periodic maintenance program.

Peter B. Dyson
Project Manager

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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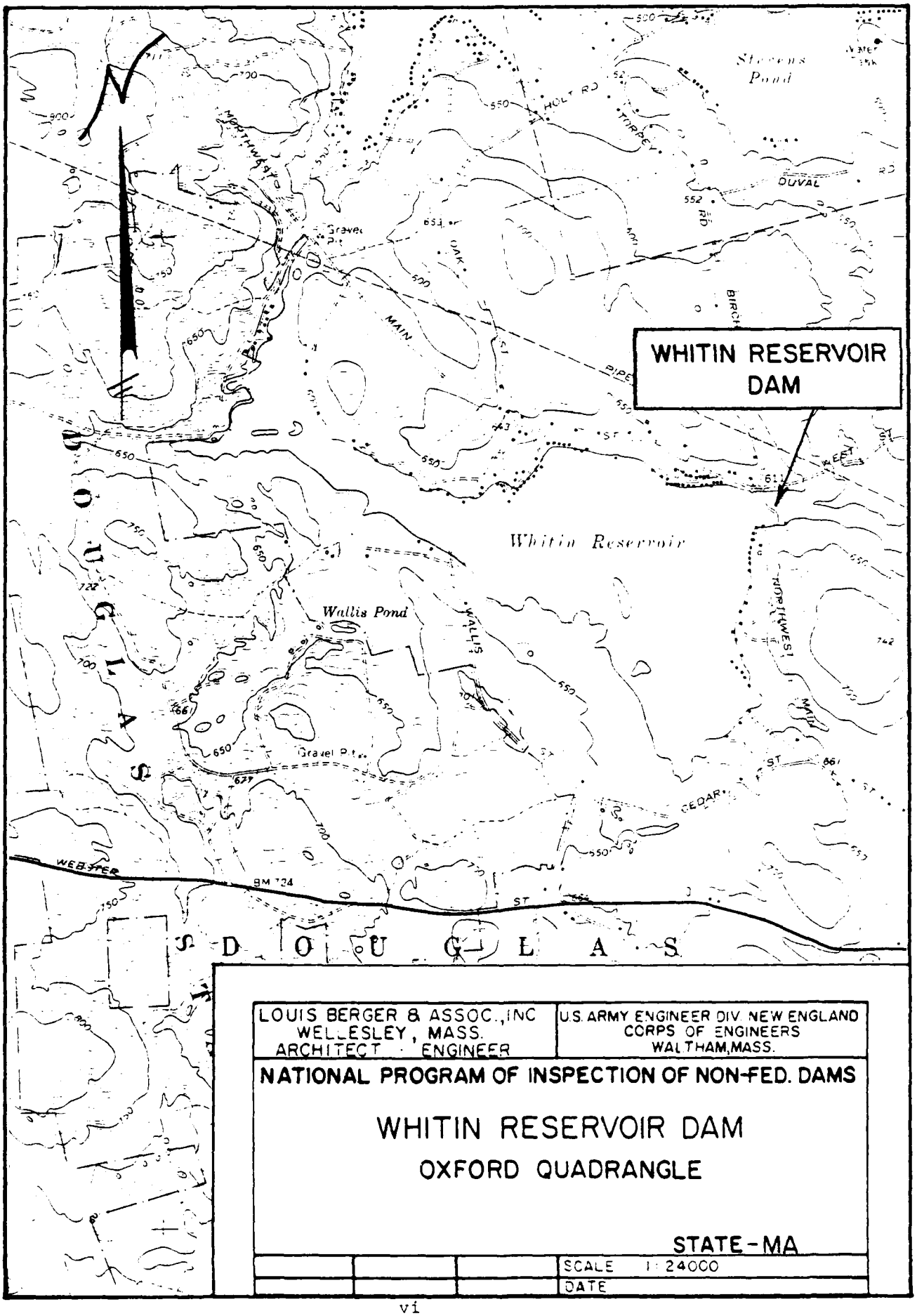
APPENDIXES

WHITIN RESERVOIR DAM

OVERVIEW FROM RIGHT ABUTMENT



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WHITIN RESERVOIR DAM

OXFORD QUADRANGLE

STATE - MA

			SCALE 1:24000
			DATE

PHASE I INSPECTION REPORT

WHITIN RESERVOIR DAM MA 00200

SECTION 1 - PROJECT INFORMATION

eral

Authority. Public Law 92-367, August 8, 1972, authorized the Secretary rmy, through the Corps of Engineers, to initiate a national program of ection throughout the United States. The New England Division of the Engineers has been assigned the responsibility of supervising the in- of dams within the New England Region. Louis Berger & Associates, Inc. retained by the New England Division to inspect and report on selected the State of Massachusetts. Authorization and notice to proceed was issued Berger & Associates, Inc. under a letter of 28 March 1980 from William E. Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0043 has been by the Corps of Engineers for this work.

Purpose of Inspection

) Perform technical inspection and evaluation of non-Federal dams to identify ons which threaten the public safety and thus permit correction in a timely by non-Federal interests.

) Encourage and assist the States to initiate quickly effective dam safety s for non-Federal dams.

) Update, verify and complete the National Inventory of Dams.

scription of Project

Location. Whitin Reservoir Dam is located in Worcester County in the Town las in south-central Massachusetts. The reservoir is situated on an unnamed approximately two miles upstream from its confluence with the Mumford River. is reached via Northwest Main Street. The dam is shown on U.S.G.S. Quad- Oxford, Mass. - Conn. - R.I. with coordinates approximately at N 42° 04' 18", 5' 29".

Description of Dam and Appurtenances

) scription of Dam. Whitin Reservoir Dam is a 33 ft. high, 473 ft. long, face stone wall dam with an earthfill embankment upstream of the wall. The cons ucted across a steep-sided valley reach of an unnamed brook. The down- face of the dam has a slight batter and the upstream face has a slope of ½ horizontal to 1 vertical. The upstream face is protected with dumped stone s been gunited at the higher elevations. The horizontal alignment of the dam a gentle "S" configuration and a paved roadway known as Northwest Main Street along the entire length of the earthfill. The crest of the dam has a variable ith a minimum of about 30 ft. Stone parapets with mortared joints are located ach edge of the crest and extend from the left abutment to the spillway facili- ar the right abutment. The parapets vary slightly in height. On the average,

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

sual Observations

tin Reservoir Dam is in good structural condition as revealed by the field ion of April 15 and May 20, 1980. However, there are several items of a l nature which were observed and which require treatment as outlined in . 7.

ncipal items requiring remedial treatment are the occasional voids in the rubble parapet wall left of the outlet structure, the need for repointing ionry rubble training wall on the right side of the main spillway, and the need ve weeds and siltation at the downstream end of the reinforced concrete on the right of the spillway inlet channel.

esign and Construction Data

:al layout plan of the Whitin Reservoir Dam prepared by G. Bertrand Bibeault August 1958 is available. However, no definitive plans of the embankment, ay and typical cross-sections are available. Data on construction of the ment including detailed laboratory soil test results are also not available. ations pertaining to the stability of the embankment and masonry rubble walls available.

ost-Construction Changes

are no formal records of any post-construction changes made to the dam or ay or outlet structure over the course of its history. However, correspondence tes the main spillway was reconstructed in 1977, and that the control structure e low level outlet was completely reconstructed after the floods of 1955. The observations indicated no items which appear to be inconsistent with the l layout plan previously noted.

eismic Stability

n is located in Seismic Zone #2 and in accordance with recommended Phase I ines does not warrant seismic analysis.

.cinity of Gilboa Pond located about three quarters of a mile below East Douglas, it is estimated that an industrial building, Gilboa Street, a sewage treatment and about seven houses will be flooded to a depth of between 1 and 6 ft. Below irea of initial impact the flood flows should be significantly reduced as they .nto Lackey Pond, Meadow Pond and Whitins Pond, all of which are impoundments of imford River.

mary, about thirteen houses, two industrial buildings, a commercial building, her building, a sewage treatment plant, a pipe line, and eight local roadways .thin the area of potential flooding and there is also the potential for the f more than a few lives (see Sheet D-25, Appendix D). Therefore, in lance with the Recommended Guidelines for Safety Inspection of Dams the dam en classified as having a high hazard potential.

:harge tables and curves for the spillway and for over the top of the dam are m on Sheets D-4 thru D-6, Appendix D. The discharge capacity of the low level .et was not considered. For determining surface areas and surcharge capacities, ıimetered areas were taken from contours delineated on 1:24,000 U.S.G.S. Sheets.

)d routings were performed for both the test flood and a ½ PMF. Results of these :ings are shown on Sheets D-10 thru D-15, Appendix D, and are summarized as .ows:

Lood ıitude	Test Flood Inflow (cfs)	Maximum Res. El. (ft. NGVD)	Max. Head Over Crest of Dam (ft.)	Routed Test Flood Outflow (cfs)
¶F	6,770	601.4	1.9	3,500
(Test Flood)	13,540	603.2	3.7	9,000

the above table, it can be seen that the project will not pass the routed test d outflow without overtopping the crest of the dam by about 4.1 ft. The project handle about 9 percent of the routed test flood outflow without overtopping the

Dam Failure Analysis

each owing to structural failure of the dam by piping or sloughing is a possi- .ty. For this analysis a breach was assumed to occur with the water surface level .op of dam. The "rule of thumb" method in the March 1978 Guidance Report was l for the breach analysis. With a breach width of 30 percent of the embankment ;th, since the mid-height length is unknown, or about 125 ft., an outflow of about '00 cfs, which includes 850 cfs from the spillway, would be realized (see Sheets) thru D-24, Appendix D). Because of the relatively small spillway discharge, downstream valley storage filled by the prefailure flow was not subtracted from .lable storage for attenuation of the dam-failure flow when routing the dam- .ure flood.

:he reach below the dam, the breach flood flows would travel down a two mile long ımed brook to the Mumford River. In this reach, it is estimated that three local lways which cross the brook would be flooded and seriously damaged. A 6 in. dia. .ned products pipeline with about a 3 ft. cover crosses the brook approximately)0 ft. below the dam and would be seriously damaged. Also, three houses in the .nity of the Mumford River would sustain severe flooding. It is estimated that breach discharge would flood these houses by as much as 3 to 5 ft., and that the .lway discharge prior to the breach would not flood these homes. When the breach :low reaches the Mumford River it is estimated that the discharge will be about)00 cfs in the brook and that the stage will be about 13 ft. higher than the stage to the spillway discharge. In the 1.8 mile reach between the confluence of the ımed brook and the Mumford River and the village of East Douglas, it is estimated : the stage in the Mumford River will rise about 11.5 ft. and flood two local lways and 3 houses will be flooded by 1 to 3 ft. of water. In East Douglas it is .mated that the breach discharge will be about 21,900 cfs. The Mumford River is ıer confined as it passes through the village and it is probable that two local lways, one mill building, one commercial building and one other building will be)ded to an additional depth of between 5 and 9 ft. Flooding will take place in

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

General. Whitin Reservoir Dam is an ashlar faced stone wall dam with an up-
eam earthfill which supports a paved roadway across the entire length of its
st. The dam impounds a normal storage of about 2,800 acre-ft. with provision
an additional 1,675 acre-ft. of capacity in its surcharge space to top of dam.
is basically a low surcharge - low spillage facility used to impound water for
reational purposes. Flows through the spillway are controlled by a constriction
the spillway approach channel. This constriction consists of a roadway embankment
at crosses the approach channel which has a 15 ft. long bridge opening and
ir 36 in. dia. concrete pipes for conveying water from the reservoir to the spill-
. With the reservoir water surface level at top of dam the spillway discharges
out 850 cfs. If the approach channel were unconstricted, the spillway would be
pable of passing about 1,480 cfs with the water surface level at top of dam.

e general topographic characteristics of the 8.93 sq. mi. (5,716 acres) drainage
ea is best described as rolling terrain, which rises from elevation 595.5 ft. at
illway crest level to elevation 900. The area is nearly all forested with a
zable amount of the area located in the Douglas State Forest. The only populated
ea is located in the lower reaches of the basin around the rims of Whitin Reser-
ir and Crystal Lake.

2 Design Data

hydrologic computations or hydraulic data has been recovered for the dam.

3 Experience Data

records are available in regard to past operation of the reservoir, nor of sur-
arge encroachments and flows through the spillway. The maximum past outflows are
known. It was reported that after the floods of 1955, the four 36 in. dia. pipes
ntioned above were installed to increase the discharge capacity of the spillway
proach channel.

4 Test Flood Analysis

drologic characteristics of Whitin Reservoir Dam and drainage area were evaluated
accordance with criteria given in Recommended Guidelines for Safety Inspection of
ms. As indicated in Section 1.2, paragraphs c and d, Whitin Reservoir Dam is
assified as intermediate in size and has a high hazard potential. The recommended
st flood for hydraulic evaluation of such a dam is a full PMF.

ecipitation data was obtained from Hydrometeorolgical Report No. 33, which for
is area of Massachusetts is about 23.5 in. of 6 hour maximum rainfall over a 10
uare mile area. This value was then reduced by 20 percent to allow for basin size,
ape and fit factors and further reduced by 0.4 in. for infiltration losses. The
x hour rainfall was distributed into one hour incremental periods as suggested in
E Publication EC 1110-2-1411.

triangular incremental unitgraph was assumed for the inflow hydrograph using a
mputed lag time of 5.6 hours to derive a time-to-peak for the triangular hydrograph
5.0 hours (see computations on Sheets D-7 and D-8, Appendix D), indicating a peak
flow of about 13,540 cfs or a CSM of about 1,520 cfs.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

1 Operation Procedures

a. General. The dam is owned and operated by the Mumford River Reservoir sociation. It is operated in conjunction with several other bodies of water to pply cooling water and a small amount of process water for mills located down- ream of the dam. Whitin Reservoir is also used as a recreational facility by operty owners located along the shoreline. In the fall the reservoir is said be drawn down to allow shoreline property owners to make repairs to boat docks d other recreational facilities.

b. Description of any Warning System in Effect. No warning system is in fect at Whitin Reservoir Dam.

2 Maintenance Procedures

a. General. There is no documented regular periodic maintenance program in fect at Whitin Reservoir Dam. There are, however, several items which require riodic maintenance, such as: the removal of debris from the crests of the spill- ys; the repair of the spillway training walls and the parapets on the crest of ie dam; keeping the approach channel clear of vegetation growth; surveillance of ie downstream wall regarding seeps; and, maintenance of the outlet facility.

b. Operating Facilities. The only operating facility for the dam is a hand erated sluice gate which regulates the flows through the low level outlet. Main- enance of this facility is said to be performed as required.

3 Evaluation

erall maintenance of the dam is generally good. Specific maintenance items are aluated as follows: The main spillway was recently reconstructed and is in good ndition with the exception of the need for repointing of the right training wall; ie main spillway has a small amount of debris on its crest; the approach channel is some vegetation growing in it; and the upstream parapet has an area that should repaired. A regular periodic maintenance program should be implemented. The ner should also establish a formal downstream warning system for the dam in the ent of an emergency.

downstream stone wall, but the seepage appeared to be clear and free from silt. The low level outlet was in an operationsl condition and the control structure appeared to be in good condition. The upstream parapet wall and the right training wall of the main spillway need a minor amount of repointing and the spillway approach channel should be cleared of vegetation and silt. There is no regular periodic maintenance program.

mortared stone and concrete training wall on the right which also serves as the left training wall of the auxiliary spillway. A short mortared stone training wall is located to the left of the main spillway. A narrow steel footbridge spans the main spillway as can be seen in Photo No. 12. This photo shows the right end of the main spillway in the foreground and the left end of the auxiliary spillway in the background. Generally, the main spillway is in good condition. However, the right training wall is in need of repointing and the footbridge is in need of cleaning and repainting.

The auxiliary spillway is located just to the right and adjacent to the right training wall of the main spillway. The spillway is about 25 ft. long and is constructed of heavy stone blocks which blend into natural ground on the right side of the spillway. The sill of the auxiliary spillway is about 1.2 ft. higher than the top of the channel iron in the main spillway. The auxiliary spillway is in good condition.

Photo No. 11 shows the roadway passing over the approach to the spillways. The waterway openings through the roadway consist of a 15 ft. long bridge opening and four 36 in. dia. pipe culverts. The pipes are located to the right of the bridge. The roadway acts as a constriction in the approach channel. There is some weed growth in the water immediately downstream of the four pipe culverts and there is also minor silting at the downstream end of these culverts.

The channel downstream of the spillways is formed by massive bedrock, which appears to be in good condition as shown on Photo No. 13. A small amount of debris is in the channel as well as on the crest of the main spillway.

The low level outlet structure is situated at about midspan of the dam and consists of a 2 ft. square stone box conduit with a control structure located on the upstream end. The control structure can be seen in Photo Nos. 1 and 9 and the outlet end of the conduit can be seen in Photo Nos. 6 and 10. Photo No. 10 was taken on 15 April when the control gate was fully closed, and Photo No. 6 was taken on 20 May when the control gate was partially open. The control for the conduit is a sluice gate which is hand operated from the deck of the outlet control structure. The control mechanism is reported to be in good condition and the entire structure is said to have been reconstructed after the floods of 1955.

d. Reservoir Area. The shorelines upstream of the dam on both the right and left abutments appear stable with no evidence of landslides or sloughing. The shores of the reservoir are moderately to steeply sloped and numerous houses dot the rim.

e. Downstream Channel. As noted above, the spillways discharge into a massive bedrock channel which later joins the regulating outlet discharge channel to form the unnamed brook which traverses down a rather steep incline until it nears the Mumford River at a point about two miles below the dam. Though no houses are located along the brook until it is in close proximity to the Mumford River, it passes under three local roadways and over a pipeline. Beyond the confluence of the brook and the Mumford River, this river flows through a series of manmade impoundments as it winds its way through the villages of East Douglas, Whitinsville, Linwood, North Uxbridge and Uxbridge before reaching the Blackstone River about 12.7 miles below Whitin Reservoir Dam.

3.2 Evaluation

The visual inspection adequately revealed key characteristics of the dam as they may relate to its stability and integrity. The dam and appurtenant works were judged to be in good physical condition. Two seeps were found at the toe of the

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Whitin Reservoir Dam took place on 15 April and 20 May 1980. On 15 April the water level was about 0.7 ft. above the channel iron sill in the main spillway and the crest of the auxiliary spillway was dry. The discharge over the spillway was estimated to be about 47 cfs. Seepage was noted at two locations at the downstream toe of the dam. The upstream parapet is in need of minor repair and the right training wall of the main spillway is in need of minor repair. There was no evidence of any major problems and in general the physical condition of the dam was judged to be good.

b. Dam. Whitin Reservoir Dam is an uncemented ashlar faced stone wall dam with an upstream earthfill. The crest length of the dam is about 473 ft. and the maximum height is about 33 ft. The top width of the dam varies, having a minimum width of about 30 ft. and a maximum width of about 75 ft. The horizontal alignment of the dam has a slight "S" shaped configuration (see Photo No. 3), and a paved roadway is located along the crest of the dam. Stone parapets are located on either side of the roadway at each edge of the crest. The parapets vary slightly in height. The upstream parapet rises about 1.5 ft. above the crest and the downstream parapet rises about 1.1 ft. above the crest. The downstream parapet has a chain link fence mounted on it (see Photo No. 4). The downstream face of the dam consists of an uncemented stone wall which has a slight batter (see Photos No. 5 and 6). Photo No. 2 is a view of the upstream face of the dam taken (by others) prior to the date of the inspection, at a time when the reservoir was drawn down. Below the parapet, the upstream slope is about 1½ horizontal to 1 vertical and the slope is protected with dumped stone which has been gunited at the higher elevations.

Two areas of seepage were noted at the toe of the downstream stone wall and are shown on Photo Nos. 7 and 8. Photo No. 7 shows seepage emanating from a point about 30 ft. left of the low level outlet. The seepage at this location was estimated to be about 2 gpm. Photo No. 8 shows the other area of seepage which is at a point about 2 ft. left of the low level outlet. The rate of flow at this location was estimated to be less than 2 gpm. The owner's representatives stated that these areas of seepage had existed for many years, essentially unchanged. The stone wall itself appeared to be in good condition and its alignment was good.

The parapet walls are in generally good condition with the exception of a small deteriorated area in the upstream parapet about 20 ft. left of the low level outlet. The paved roadway between the parapets is in fair condition with sporadic and longitudinal cracking; however, this should be of no significance with regard to the safety of the dam. Where visible, the stone protection on the upstream slope appeared to be in good condition.

c. Appurtenant Structures. The spillways for the facility are located on the right side of the dam adjacent to the right abutment. The facilities consist of a main spillway located on the left and an auxiliary spillway located on the right, an approach channel and a discharge channel. The main spillway has a crest length of 27.5 ft. and is a concrete structure which is probably founded on bedrock. It has a 6 in. high channel iron mounted on its concrete crest and stanchions are located in the spillway for the support of stoplogs. The main spillway has a short

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No data on the design of the dam or appurtenances has been recovered. One plan dated 1958 showing a sketch of the dam in plan view was recovered and is included in Appendix B. In the course of the inspection, measurements were taken and a sketch plan and profile layout of Whitin Reservoir Dam and spillway has been prepared. This plan is also included in Appendix B.

2.2 Construction Data

No records or correspondence have been found regarding construction data.

2.3 Operation Data

No engineering operational data were disclosed.

2.4 Evaluation of Data

a. Availability. There was no engineering data available. The basis of the evaluation presented in this report is principally the visual observations of the inspection team.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. Not applicable.

(4) Gates - None

(5) U/S Channel - Obstructed by roadway across channel with 15' long bridge and 4-36 in. dia. pipes

(6) D/S Channel - Natural channel in bedrock

(7) General -

Spillway (Auxiliary)

(1) Type - Granite block gravity section

(2) Length of weir - 28 ft.

(3) Crest elevation - 596.2

(4) Gates - None

(5) U/S Channel - Same as above

(6) D/S Channel - Same as above

j. Regulating Outlets

(1) Invert - 566.5

(2) Size - 2 ft. x 2 ft. square

(3) Description - Stone Box conduit

(4) Control mechanism - Hand operated sluice gate

e. Storage (acre-ft.)

(1) Normal pool - 2,800

(2) Flood control pool - Not applicable

(3) Spillway crest pool - 2,800

(4) Top of dam - 4,475

(5) Test flood pool - 5,900

f. Reservoir Surface (acres)

(1) Normal pool - 315

(2) Flood-control pool - Not applicable

(3) Spillway crest - 315

(4) Top of dam - 382

(5) Test flood pool - 419

g. Dam

(1) Type - Stone wall with upstream earth embankment

(2) Length - 473 ft.

(3) Height - 33 ft.

(4) Top width - Varies, 30 ft. minimum

(5) Side slopes - Downstream: Slight Batter
Upstream: 1½ horizontal to 1 vertical

(6) Zoning - Unknown

(7) Impervious core - Unknown

(8) Cutoff - Unknown

(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway (Main)

(1) Type - Concrete gravity section surmounted with 6 in. high channel iron sill

(2) Length of weir - 27.5 ft.

(3) Crest elevation - 595.0

concrete pipes under the roadway. Thus the total capacity of the spillway is only about 850 cfs when the reservoir water surface level is at top of dam, elevation 599.5.

(4) Ungated Spillway Capacity at Test Flood Elevation. Because of the spillway approach control described in (3) above, the ungated spillway capacity is about 3,800 cfs when the reservoir water surface level is at test flood elevation 603.2.

(5) Gated Spillway Capacity at Normal Pool Elevation. Not applicable

(6) Gated Spillway Capacity at Test Flood Elevation. Not applicable

(7) Total Spillway Capacity at Test Flood Elevation. The total spillway discharge at the test flood elevation is the same as (4) above, 3,800 cfs at test flood elevation 603.2.

(8) Total Project Discharge at Top of Dam. With the low level outlet open the total project discharge at top of dam is about 970 cfs at elevation 599.5.

(9) Total Project Discharge at Test Flood Elevation. The total project discharge at test flood is 9,000 cfs at elevation 603.2.

c. Elevation (ft. N.G.V.D.)

(1) Streambed at toe of dam - 566.5

(2) Bottom of cutoff - Unknown

(3) Maximum tailwater - Unknown

(4) Normal pool - 595.0

(5) Full flood control pool - Not applicable

(6) Spillway crest - 595.0

(7) Design surcharge (Original Design) - Unknown

(8) Top of dam - 599.5

(9) Test flood surcharge - 603.2

d. Reservoir (Length in feet)

(1) Normal pool - 10,000

(2) Flood control pool - Not applicable

(3) Spillway crest pool - 10,000

(4) Top of dam - 10,200

(5) Test flood pool - 10,300

e. Ownership. Whitin Reservoir Dam is owned by Mumford River Reservoir Association, c/o Mr. Joseph Rosol, ATF Davidson, Main St., Whitinsville, Massachusetts 01588. Telephone: (617) 234-7451.

f. Operator. Mr. Joseph Rosol, ATF Davidson, Main Street, Whitinsville, Massachusetts 01588. Telephone: (617) 234-7451

g. Purpose of Dam. The dam impounds a reservoir used for recreational purposes. Also, the dam still serves its original purpose of supplying the water needs of mills located downstream on the Mumford River.

h. Design and Construction History. It is not known by whom the dam was designed or constructed. It is believed the dam was built in 1854 to meet the water demands of mills located downstream on the Mumford River. Correspondence in the owner's files indicates that the main spillway was completely reconstructed in 1977. The files also indicate that the masonry and steel structure for the low level outlet facility was reconstructed after the floods of 1955. At that time the four 36 in. dia. pipe culverts were also installed in the embankment to increase the discharge capabilities of the spillway approach channel.

i. Normal Operating Procedures. No written operating procedures for the dam were disclosed. According to the owner's representatives, the low level outlet sluice gate is operated from time to time and the reservoir is drawn down in the fall in anticipation of spring runoff and for the benefit of property owners located along the rim of the reservoir.

1.3 Pertinent Data

a. Drainage Area. The drainage area contributing to Whitin Reservoir is situated at the headwaters of an unnamed stream leading to the Mumford River. The drainage area encompasses a total of about 8.93 sq. mi. (5,716 acres), of which 315 acres are occupied by the reservoir. The longest circuitous stream course leading to the dam is about 4.7 miles long with an elevation difference of about 295 ft., or at a slope of about 63 ft. per mile. The drainage area has a length of about 3.6 miles and an average width of 2.3 miles. The basin consists of forested areas with a few open fields in the lower reach. The only populated areas are along the rim of the reservoir.

b. Discharge at Damsite

(1) Outlet Works Conduit. Low level discharge from Whitin Reservoir is provided for by means of a 2 ft. square stone box conduit which is located at about midspan of the dam and passes through its base. The outlet of the conduit has an invert elevation of 566.5 ft. The conduit would be capable of discharging about 120 cfs when the sluice gate was wide open and the reservoir water surface level was at the top of the dam.

(2) Maximum Known Flood at Damsite. No records are available of flood inflows into Whitin Reservoir, nor of spillway releases and surcharge heads during such inflows.

(3) Ungated Spillway Capacity at Top of Dam. About 50 ft. upstream from the spillway crest a roadway crosses the spillway approach channel. Inflows to the spillway are controlled by a 15 ft. long bridge opening and four 36 in. dia.

top of the upstream parapet is about 1.5 ft. higher than the crest of the embankment. The top of the downstream parapet is about 1.1 ft. high and is surmounted by a chain link fence. A sketch plan can be found in Appendix B.

(2) Spillway. The spillway facilities for Whitin Reservoir Dam are located in the embankment near the right abutment. The facilities consist of a main spillway, an auxiliary spillway, an approach channel and a discharge channel. The main spillway is a 27.5 ft. long concrete structure which is probably founded on bedrock. A 6 in. high channel iron is mounted on its concrete crest. The top of dam is 4.5 ft. above the top of the channel iron. The spillway has a short rubble masonry and concrete training wall on the right and a short rubble masonry training wall on the left. The spillway is spanned by a narrow steel bridge. The auxiliary spillway is located just to the right and adjacent to the right training wall of the main spillway. This spillway is about 25 ft. long and is constructed of heavy stone blocks which blend in with the natural ground on the right side of the spillway. The sill of the auxiliary spillway is about 1.2 ft. higher than the top of the channel iron in the main spillway. The approach channel which serves both spillways is about 80 ft. long and is constricted at its upstream end by a bridge and culvert under the roadway along the dam. The waterway opening through the roadway embankment consists of a 15 ft. long bridge and four 36 in. dia. concrete pipes. The elevation on the roadway pavement in this vicinity is slightly lower than the remainder along the earth embankment of the dam. The channel below the spillways traverses down a relatively steep slope and its floor is made up of bedrock and massive boulders.

(3) Low Level Outlet. The low level outlet for the dam is situated at about mid-span, where a masonry and steel control structure is located about 15 ft. upstream of the parapet. The low level conduit is a 2 ft. square stone box that outlets at the toe of the downstream ashlar faced wall. The control for the facility is a hand operated sluice gate which is operated from the deck of the outlet structure. There is a staff gage located on the outlet structure which is not in use and the deck of the structure is enclosed by a low chain link fence.

c. Size Calssification. Whitin Reservoir Dam has a hydraulic height of about 33 ft. above downstream river level, and impounds a normal storage of about 2,800 acre-ft. to spillway crest level and a maximum of about 4,475 acre-ft. to top of dam. In accordance with the capacity criteria given in Recommended Guidelines for Safety Inspection of Dams, the project falls into the intermediate category on the basis of height and capacity and is therefore classified accordingly.

d. Hazard Classification. A breach failure of Whitin Reservoir Dam would release water down a two mile long unnamed brook into the Mumford River and thence along the Mumford River Valley. Three local roadways, three houses and a Mobil Oil Co. refined products pipelines (6 in. dia.) located along the unnamed brook would be subject to flood waters from the breach. It is estimated that the stage in the brook would rise about 13 ft. above the stage due to the spillway discharge. From the confluence of the unnamed brook and the Mumford River to a point about 1 mile below the Village of East Douglas, which is located about four miles below the dam, it is estimated that about ten houses, two industrial buildings, one commercial building, one other building, a sewerage treatment plant and several local roadways would also be flooded as the stage in the Mumford River would rise by as much as 15 ft. The range of flooding would vary between 1 and 9 ft. It is estimated that the prefailure spillway discharge would not cause any significant flooding damage in the reaches described above. In this area of initial impact it is estimated that there is also the potential for the loss of more than a few lives. In accordance with the Recommended Guidelines for Safety Inspection of Dams, Whitin Reservoir Dam has therefore been classified as having a high hazard potential.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the Phase I visual examination, Whitin Reservoir Dam is judged to be in good physical condition, but because of the inadequate spillway discharge capacity it is rated as in fair condition. The deficiencies reveal that a further investigation should be carried out and that some remedial work is needed. The major concern revealed by the Phase I investigation is that the spillways will only pass about 8 percent of the routed test flood outflow.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Urgency. The recommendations and remedial measures enumerated below should be implemented by the owner within one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the owner, the Mumford River Reservoir Association, should retain the services of a registered professional engineer experienced in the design of dams to make a thorough study of the hydrology of the drainage basin and evaluate further the potential for overtopping and the adequacy of the spillways and their approach channel. If proved necessary, appropriate remedial works should be designed and constructed.

7.3 Remedial Measures

a. Operation and Maintenance Measures

(1) Repair voids in the upstream parapet at a point about 20 ft. left of the low level outlet structure.

(2) Repoint the masonry rubble portion of the right training wall of the main spillway.

(3) Remove weeds and siltation in the approach channel downstream of the four 36 in. dia. pipe culverts.

(4) Monitor seepage at the toe of the downstream face of the stone wall to the left of the low level outlet structure on a six month basis to ascertain any changes in clarity or quantity of flow.

(5) Develop an "Emergency Action Plan" that will include an effective pre-planned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation. The plan will also include round-the-clock monitoring of the project during periods of heavy precipitation.

(6) Clean and repaint the footbridge.

(7) Continue to conduct annual technical inspections of the dam and its appurtenant structures.

(8) Implement a regular periodic maintenance program.

7.4 Alternatives

There are no feasible alternatives to the above recommendations.

Appendix A

Inspection Checklist

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT WHITIN RESERVOIR DAM

DATE 15 April and 20 May 1980

OWNER Mumford River Reservoir Association

TIME 15 April: 9:30 AM
20 May: 9:00 AM

WEATHER 15 April: Clear, Mild
20 May: Clear, Warm

W.S. ELEV. 595.7 U.S. NA DN.S.

INSPECTION PARTY

A/E REPRESENTATIVES	OWNER'S REPRESENTATIVES
1. Peter B. Dyson	1. Joseph Rosol
2. Pasquale E. Corsetti	2. Carl Feraco
3. Roger F. Berry	3. Delwyn K. Barnes
4. Carl J. Hoffman	4.
5. William Z. Zoino	5.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrologic	Roger F. Berry	LBA
2.	Hydraulics/Structures	Carl J. Hoffman	LBA
3.	Soils and Geology	William S. Zoino	GZA
4.	General Features	Peter B. Dyson	LBA
5.	General Features	Pasquale E. Corsetti	LBA
6.			
7.			
8.			
9.			
10.			

LBA - Louis Berger & Associates, Inc.
GZA - Goldberg-Zoino & Associates, Inc.

PERIODIC INSPECTION CHECKLIST

PROJECT WHITIN RESERVOIR DAM DATE 20 May 1980

PROJECT FEATURE Stonewall Dam NAME

DISCIPLINE Soils/Geology NAME William S. Zoino

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	599.5
Current Pool Elevation	595.7
Maximum Impoundment to Date	Unknown
Surface Cracks	Numerous minor cracks in paved roadway surface.
Pavement Condition	Fair
Movement or Settlement of Crest	None, but somewhat irregular across crest
Lateral Movement	None
Vertical Alginment	Good
Horizontal Alignment	Curved, but visually appears good.
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	Missing stones in U/S parapet 20 ft. left of low level outlet
Trespassing on Slopes	None
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	2 seepage spots at base of D/S wall: one 20 ft. left of low level outlet issuing about 2 gpm; one 2 ft. left of low level outlet
Piping or Boils	None
Foundation Drainage Features	None evident
Toe Drains	None evident
Instrumentation System	None evident

PERIODIC INSPECTION CHECKLIST

PROJECT WHITIN RESERVOIR DAM DATE 15 April 1980

PROJECT FEATURE Outlet Control Tower NAME

DISCIPLINE Hydraulics/Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	Structural Steel Tower
General Condition	Good
Condition of Joints	N/A
Spalling	N/A
Visible Reinforcing	N/A
Rusting or Staning of Concrete	N/A
Any Seepage or Effloresence	N/A
Joint Alignment	N/A
Unusual Seepage or Leaks in Gate Chamber	Unknown
Cracks	N/A
Rusting or Corrosion of Steel	Minor
b. Mechanical and Electrical	None
Air Vents	N/A
Float Wells	N/A
Crane Hoist	N/A
Elevator	N/A
Hydraulic System	N/A
Service Gates	N/A
Emergency Gates	N/A
Lighting Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System in Gate Chamber	N/A

PERIODIC INSPECTION CHECKLIST

PROJECT WHITIN RESERVOIR DAM DATE 15 April 1980

PROJECT FEATURE Outlet Conduit NAME

DISCIPLINE Hydraulics/Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	N/A - See note below.
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	N/A
Visible Reinforcing	N/A
Any Seepage or Efflorescence	Not observed
Condition at Joints	Not observed
Drain Holes	Unknown
Channel	
Loose Rock or Trees Overhanging Channel	Yes
Condition of Discharge Channel	Good

Note: Outlet conduit is a stone box culvert which is not visible.

PERIODIC INSPECTION CHECKLIST

PROJECT WHITIN RESERVOIR DAM DATE 15 April 1980

PROJECT FEATURE Spillway NAME

DISCIPLINE Hydraulics/Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Vegetation growing
b. Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	None
Spalling	None
Any Visible Reinforcing	None
Any Seepage or Efflorescence	No
Drain Holes	N/A
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Yes
Floor of Channel	Ledge
Other Obstructions	None

PERIODIC INSPECTION CHECKLIST

PROJECT WHITIN RESERVOIR DAM DATE 15 April 1980

PROJECT FEATURE Spillway Bridge NAME

DISCIPLINE Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	
a. Superstructure	
Bearings	Good
Anchor Bolts	Good
Bridge Seat	Good
Longitudinal Members	Good
Underside of Deck	Good
Secondary Bracing	N/A
Deck	Good
Drainage System	N/A
Railings	Good
Expansion Joints	N/A
Paint	Fair
b. Abutment & Piers	
General Condition of Concrete	Good
Alignment of Abutment	Good
Approach to Bridge	Good
Condition of Seat and Backwall	N/A

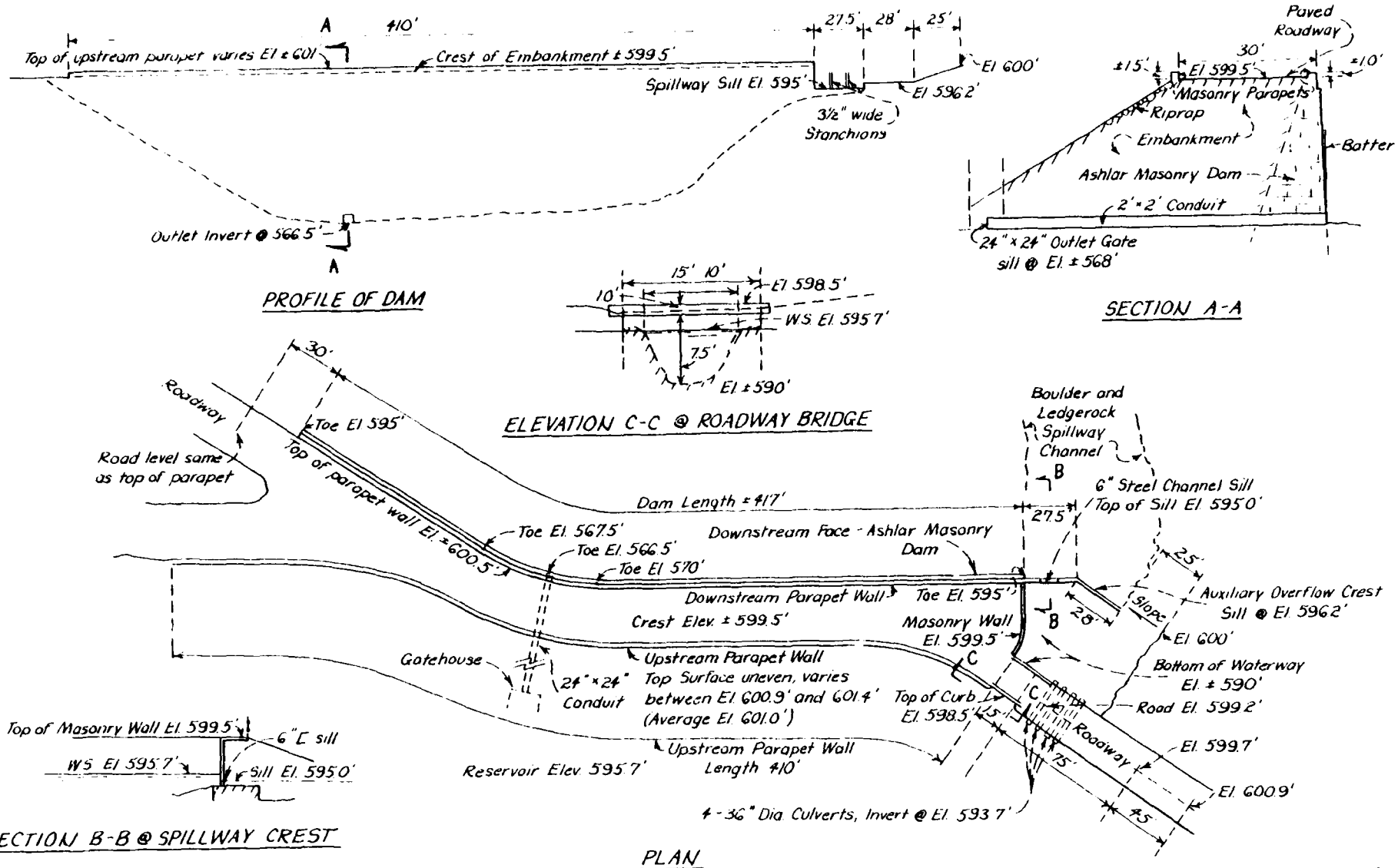
PERIODIC INSPECTION CHECKLIST

PROJECT: WHITIN RESERVOIR DAM DATE: 15 April 1980

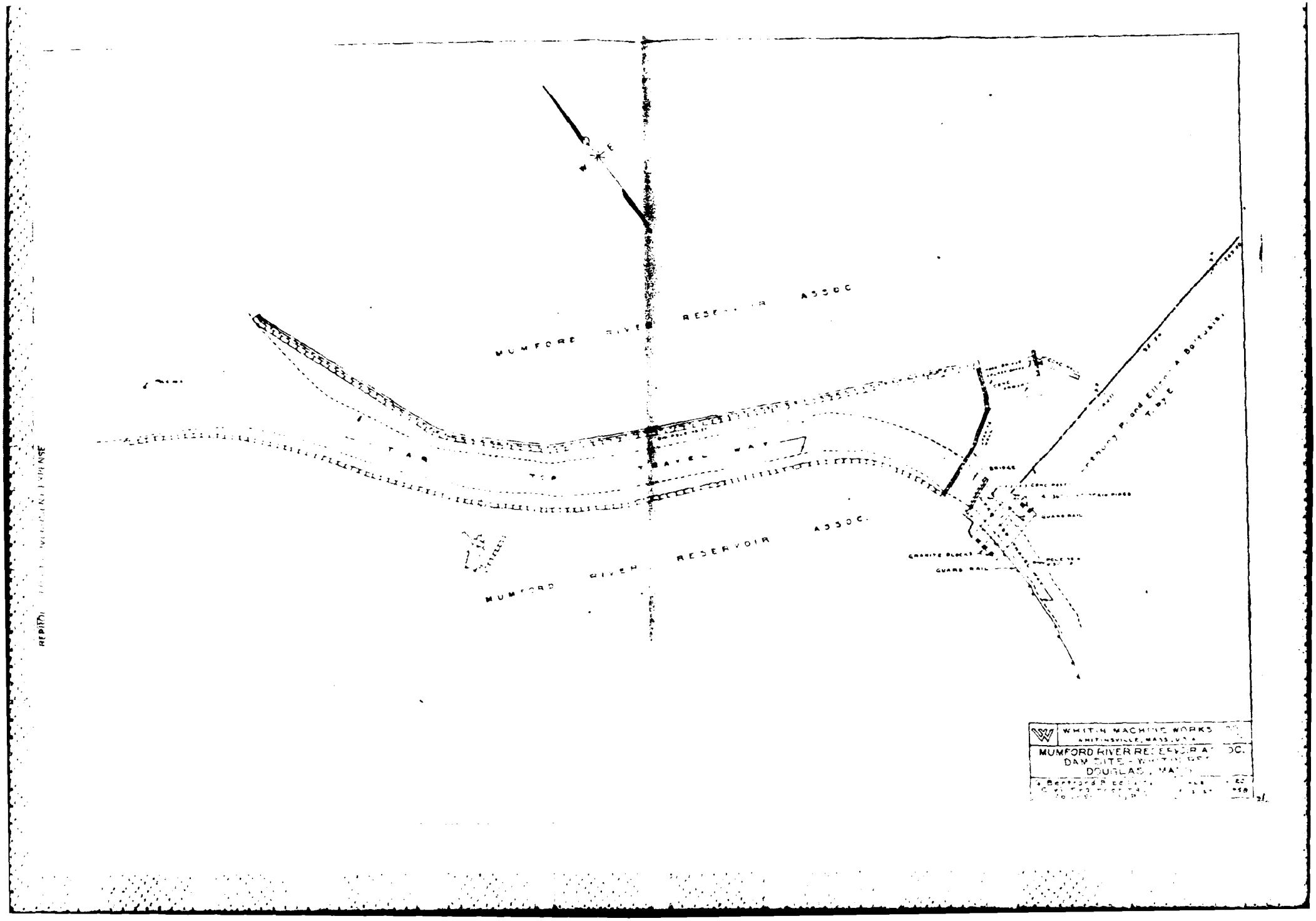
AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT	N/A
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	N/A
OUTLET WORKS - TRANSITION & CONDUIT	N/A

Appendix B

Engineering Data



WHITIN RESERVOIR DAM


MUMFORD RIVER RESERVOIR ASSOC
MUMFORD RIVER RESERVOIR ASSOC.
TAR
GRANITE BLOCK
GUARD RAIL
WHITIN MACHINE WORKS
MUMFORD RIVER RESERVOIR ASSOC.
DAM SITE - WHITINSVILLE
DOUGLAS, MASS.

(26) TOWN OR CITY Douglas DECREE NO. PLAN NO. 1938 Flood DAM NO. 13-07

LOCATION 3 m. west of E. Douglas - Wallis Pond Reservoir C. C. DOCKET NO.

B-3

DESCRIPTION OF DAM

Type	Hy Emb - ½:1 down & 1½ riprap upstream dry wall
Length	300
Height	32.
Thickness top	36.
" bottom	60.
Downstream Slope	½:1 dry wall
Upstream "	1½:1 Riprap
Length of Spillway	El. crest = 96.0 29.
Size of Gates	El. 68-70 4x4
Location of Gates	180 from No. End Dam.
Flashboards used	Yes. El. 100
Width Flashboards or Gates	4
Dam designed by	
" constructed by	
Year constructed	

GENERAL REMARKS

Owned by the Mumford River Reservoir Assn.
Write Whitin Machine Works Whitinsville.
Inspected: Sept. 15, 1924 - L.O. Marden
" Aug 1, 1928 " "
" June 11, 1931 " "
" Oct 5, 1933 " "
" March 30, 1937 - K.M.F - Willard Burrage
" May 17, 1939 - L.H.S. & M.F.H.
" Oct 25, 1938 - L.H.S.

DESCRIPTION OF RESERVOIR & WATERSHED

Name of Main Stream	Mumford River
" " any other Streams	
Length of Watershed	
Width " "	
Is Watershed Cultivated	
Percent In Forests	60%
Steepness of Slope	
Kind of Soil	
No. of Acres In Watershed	0.80 Sq M
" " " " Reservoir	Cu. Ft. Cap = 180,000,000 gal. 250
Length of Reservoir	
Width " "	
Max Flow Cu. Ft per Sec.	
Head or Flashboards-Low Water	
" " " -High "	

GENERAL REMARKS

Reservoir
March 17, 1939 - J.B. Tykula - J.C. Powers
Inspected: July 13, 1943 L.O.M
" Sept 9, 1944 "
" 12-11-45 - K.M.F
" 5-15-47 - L.O.M.
" 11-18-46 " R.K. Barnes
" Jan 1953 L.H. SPOFFORD & DELBERT BARNES
" 11-21-51 - LHS

Douglas DAM NO. 13-07

Willis Pond Reservoir STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Mumford River Reservoir Assn write
NY Whitin Machine Works PLACE Whitinsville USE storage

ED BY L.O.Marden DATE May 15,1947

DAM High earthern hy emb. stone supporting walls, stone spillway CONDITION good

WAY

ASHBOARDS IN PLACE yes RECENT REPAIRS none

NDITION good

EPAIRS NEEDED none

NKMENT

ECENT REPAIRS none

ONDITION good

EPAIRS NEEDED none

S

ECENT REPAIRS none

ONDITION good

EPAIRS NEEDED none

S

OW SERIOUS none visible

DATE May 15,1947

L.O. Marden
COUNTY ENGINEER

B-17

Douglas DAM NO. 13-07

ON Douglas STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

BY Mumford River, Res. Ass'n PLACE Whitinsville USE storage

TED BY LOM-D.K.Barnes DATE Nov.18,1946

F DAM CONDITION

LWAY

LASHBOARDS IN PLACE RECENT REPAIRS

ONDITION OK

EPAIRS NEEDED

ANKMENT

ECENT REPAIRS

ONDITION OK

EPAIRS NEEDED

ES

ECENT REPAIRS

ONDITION OK

EPAIRS NEEDED

KS

OW SERIOUS none visible.

DATE Nov. 18,1946

COUNTY ENGINEER

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

pected by RMF Date 12-11-45 Dam No. 13-07

wn Douglas Location Willis Pond

ner Estate Mack Use Storage

terial and Type

m Designed by Constructed by Year

ILLWAY.

top Abutment El. Crest El. Apron El. Streambed

dth top Abutment Width top Crest Width bottom Spillway

dth Flashboards carried Kind Flashboards

Flowline Cleanout Pipe Size and Kind Cleanout Pipe

nd of Foundation under Spillway

ndition Good — pond 6' ± Below Good River

MBANKMENT

. Top El. Natural Ground Width Top

idth of Bottom Upstream Slope Downstream Slope

nd of Corewall Riprap

aterial in Embankment Foundation

ndition Good

ATES Location

pe Kind El. Flowline

ndition Good

HEEL None Kind Size Rated H. P.

cation Ave. Head

ridence of Leaks in Structure

cent Repairs and Date

pography of Country below Dam

ature of Buildings and Roads below Dam

umber Acres in Pond Drainage Area in Square Miles

scharge in Second Feet per Square Mile

timated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEERING DEPT.
WORCESTER, MASS.

DATE 9-12-44

SUBJECT: Dam No. 13-07 - Douglas - Willis Pond Res.

This high earthern embankment highway dam with up and downstream dry breast walls in good condition.

AR USED

AR MILEAGE

END TRIP

BEGIN TRIP

TRIP MILES

So Worden

SIGNATURE

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L H Spafford Date Dec 15 / 40 Dam No. 13-07

Town Douglas Location Willis Pond

Owner Worth Mach Co Use Impounding

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried None Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Good -

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition

GATES 1 Location Embankment

Size Kind El. Flowline

Condition Good - open about 5" and taking entire flow - 4' about 5' below crest of spillway

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None

Recent Repairs and Date None

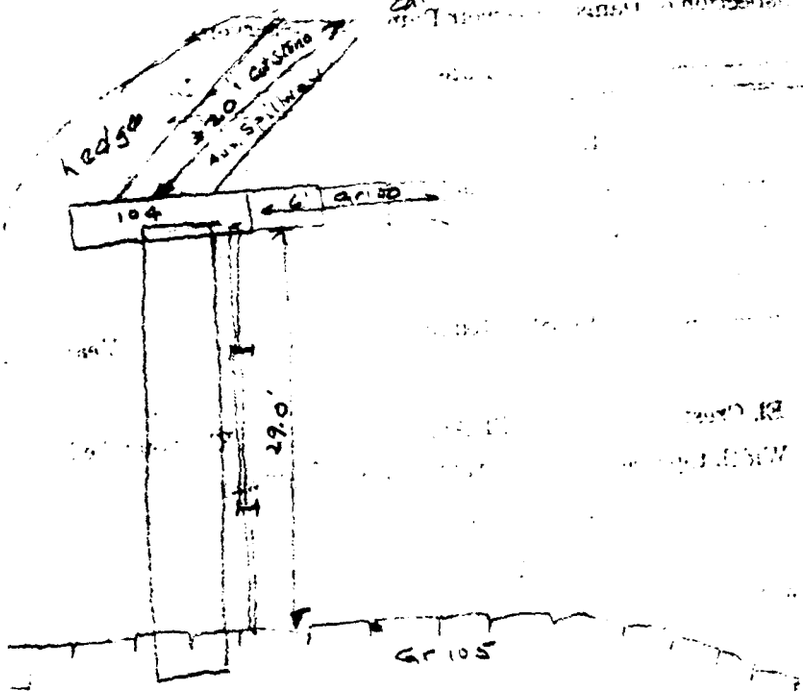
Topography of Country below Dam

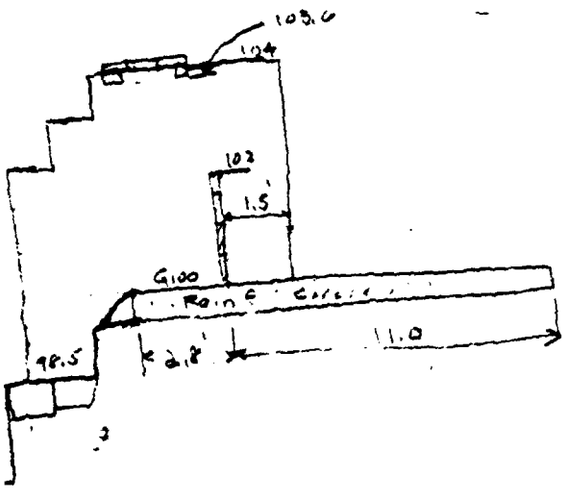
Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet





Drainage from head scraw operated gate in center of embankment

2'x2' stone box

Invert = G 7 3

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by J.H.S. + M.F.H. Date 5/17/39 Dam No. 13-07

Town Douglas Location Willis Pond

Owner Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Good

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Good

GATES Location

Size Kind El. Flowline

Condition Good

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by J.C.P. & I.T. Date 3/14/39 Dam No. 12-27

Town Douglas Location Wills Road

Owner Whitin Machine Wks Use Reservoir

SPILLWAY

El.top abutment _____ El.Crest _____ El.Apron _____ El.Ct.Bed ___

Width top Abut. _____ Width top Crest _____ Width bottom Sp.way _____

Width flashboards _____ Kind Flashboards _____

El.Flowline Cleanout Pipe _____ Size and Kind Pipe _____

Kind of Foundation under Spillway _____

Condition Water tight [illegible] _____

_____

EMBANKMENT

El. Top _____ El.Natural Ground _____ Width Top _____

Width of Borrom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition _____

_____

_____

GATES _____ Location _____

Size _____ Kind _____ El.Flowline _____

Condition _____

_____

_____

Evidence of Leaks in Structure _____

_____

Recent Repairs and Date _____

_____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by L.H.Spofford Date Oct.25,1938 Dam No. 13-07

Town Douglas Location Willis Pond Reservoir

Owner Whitin Machine Works Use Impounding

SPILLWAY Cone apron 28' x2' stone side walls. Also aux.spillway 24" higher than main spillway 20' long-stone apron

El.top Abutment El.Crest El.Apron El.St.Bed

Width top Abut. Width top Crest Width bottom Sp.way

Width flashboards Provision for 24" of boards Kind Flashboards in I beam guides

El.Flowline Cleanout Pipe Size and Kind Pipe

Kind of Foundation under Spillway

Condition Excellent - no flashboards on this date - no evidence of any trouble from September flood.

EMBANKMENT Earth about 30 ft.high - good drystone wall on downstream side Highway on top - heavy riprap on upstream side

El.Top E..Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Excellent - no damage whatever

GATES 1 large flood gate controlling entire flow on this date.

Location

Size Kind El.Flowline

Condition Located in stone pier in center of embankment- pond side - operated by means of large lead screw - well oiled and in good operating condition.

Evidence of Leaks in Structure none

Recent Repairs and Date none

Number Acres in Pond Drainage Area in Sq.Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by KmF. Willard Burnap Date 3-30-37 Dam No. 13-07

Town Douglas Location Willis Pond Reservoir

Owner Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK, floor of spillway has been paved with concrete.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.Marden Date Oct.5, 1933 Dam No. 13-07

Town Douglas Location Douglas Reservoir

Owner Whitin Machine Works Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition OK

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition OK

GATES Location

Size Kind El. Flowline

Condition OK

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None visible

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

B-7

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.Marden -Burnap Date 6-11-31 Dam No. 13-07

Town Douglas Location Douglas Res.

Owner Use

Material and Type High water acct 6 days rain-water was 6" over top wood frame of gate.

Dam Designed by Constructed by Year

SPILLWAY—Length Feet. Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition cleaned out-O.K.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition O.K.

GATES Location

Size Kind El. Flowline

Condition O.K.

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure small seepage one spot downstream wall.

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

Write Whitin's Machine Works.

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.M. Date 8.1.28 Dam No. 13-07

Town Douglas Location 1 mi. W East Douglas.

Owner Mumford River Res. Ass. Use

Material and Type Highway Emb.

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards 24" flashboard carried pond high;

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Flashboard Frame etc. painted recemented would suggest taking off one row of flash boards. cut off brush in walls.

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition good. would syggest cutting off brush at downstream side emb. so that ex mination can be made for leaks.

GATES Location

Size Kind El. Flowline

Condition good.

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure none that can be determined.

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

Decree No. Dam No. 13-07

COUNTY OF WORCESTER, MASSACHUSETTS
OFFICE OF COUNTY ENGINEER

Neg. Nos.

INSPECTION OF DAMS, RESERVOIR DAMS AND RESERVOIRS

Town Douglas Date Sept. 15, 1924 Dam No.

Location 3 ml. W. E. Douglas Name of Pond or Stream Mumford River Willis Pond Reservoir

Inspected by L.O.Marden

Owner Use Storage

MATERIAL & TYPE Earth about 1½:1 D.S. dry stone wall Hy. Emb.

Elevations in feet: above (+) or below (-) full pond or reservoir level.

FOR DAM Bed of stream below 32 from top wall top of spillway 96

FOR RESERVOIR

top of dam 102 top of flashboards 4'-0" using 10" flashboards ground surface below 98

level of overflow pipe length in feet 500'

width top in feet 36'-0" width bottom in feet 60+- size pipe to mill

inches length spillway in feet 29+30' additional 10' span. head in feet

Size of wheel none H. P. developed

Size of gates 4x4 opening location of gates 180' from N. end

Foundation and details of construction Both sided mortared granite wall earth fill used as highway condition of embankment good

Constructed by date

Designed by location

Recent repairs and date

Evidence of leakage none

Condition good

Topography of country below wooded

Nature of buildings and roads below dam none possible 3 or 4 farm houses

No. Acres in watershed No. Acres in pond

Plans secured Percent watershed in cultivation

Percent in forests Note: Cross out word not applicable

road on top
¼:1 slope downstream
1½:1 slope riprap upstream

B-4

TOWN Douglas DAM NO. 13-07

LOCATION Wills Pond. Res STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY PLACE USE Impounding

INSPECTED BY H Spofford DATE 11/21/51

TYPE OF DAM CONDITION

SPILLWAY

FLASHBOARDS IN PLACE None RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

Gate 2/3 open and entire flow going thru at this time

EMBANKMENT

RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

GATES

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN Douglas

LOCATION Wallis Road

DAM NO. 13-07

STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Whitin Machine Co PLACE USE Impounding

INSPECTED BY Lt Bradford & Mr Barnes 1/8/53

TYPE OF DAM Earth Dam - Stone Breast Wall. CONDITION

SPILLWAY

FLASHBOARDS IN PLACE None. RECENT REPAIRS None.

CONDITION Good.

REPAIRS NEEDED None

EMBANKMENT

RECENT REPAIRS None

CONDITION Good - Recent repairs at drow off gate - concrete laid on rip raps -

REPAIRS NEEDED

GATES

RECENT REPAIRS None

CONDITION Good (Lead down)

REPAIRS NEEDED None.

LEAKS

Old leak pretty much stopped by application of concrete to rip raps on both sides.

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN Douglas DAM NO. 13-07

LOCATION Wallis Pond or Whitin Reservoir STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Mumford River Res. Assn. with Whitin Machine Works PLACE Whitinsville USE Impounding

INSPECTED BY H. Spofford DATE 11/8/54

TYPE OF DAM CONDITION

SPILLWAY

FLASHBOARDS IN PLACE ± 2 ft RECENT REPAIRS

CONDITION Fair - some boards washed out - these boards ought to

REPAIRS NEEDED be all taken off this fall - pond is now going around end of stone spillway & cutting new channel down thru the woods

EMBANKMENT

RECENT REPAIRS

CONDITION Good

REPAIRS NEEDED

GATES Head Screw type

RECENT REPAIRS

CONDITION Good - about half open now - stem

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN Douglas DAM NO. 13-07

LOCATION Willis Reservoir STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY PLACE USE

INSPECTED BY L H Spafford DATE 8/24/55

TYPE OF DAM CONDITION

SPILLWAY

FLASHBOARDS IN PLACE ±12" RECENT REPAIRS

CONDITION Good - water now going over storm spillway

REPAIRS NEEDED everything O.K

EMBANKMENT

RECENT REPAIRS

CONDITION Good - not eroded by flood

REPAIRS NEEDED

GATES

RECENT REPAIRS

CONDITION Good - about half open at this date

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN Douglas DAM NO. 13-07

LOCATION Whitinsville or Mumford Rec STREAM Trib Mumford River

Late Geod. Map called "Wallis Res

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mumford River Res. Co Place whitinsville Use _____

Inspected by P. B. Walker - D. Barnes Date oct. 6. 1961

Type of Dam L.O. Marden Condition _____

W. side Rd at spillway - New Bridge after '55 flood

SPILLWAY 4 - 36" r.c. pipe.

Flashboards in Place yes - downstream Recent Repairs _____

Condition _____

Repairs Needed To remove or replace structure and construct self failing Flashbds - 2 Feet high -

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs None

Condition Have Maintained structure

Repairs Needed None - Have done grouting around the gate structure.

LEAKS

How Serious _____

DATE: Oct. 6. 1961 L.O. Marden County Engineer

TOWN Douglas DAM NO. 13-07

LOCATION Willis Pond Rec STREAM

"Whitins Res"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mumford Rec. Co. owner Place Douglas Use

Inspected by Whitin Works-one of owners L.O. M. Don Bacas Date April 5, 1962

Type of Dam Condition

SPILLWAY

Flashboards in Place 19" & 20" Bds 1962 spring Recent Repairs 3"

Condition New Cat Walk - Structural Steel - 12" [- 20#

Repairs Needed Failing type Pins

EMBANKMENT

Recent Repairs Hy Emb

Condition Good

Repairs Needed OK

GATES

Recent Repairs 1961 - & 1962

Condition Good. - New Cyclone Fence.

Repairs Needed None

LEAKS

How Serious Some seepage No. side spill

DATE: ~~4-4~~ 4-4-1962 LOM Don Bacas County Engineer

TOWN Douglas DAM NO. 13-07

LOCATION On Northeast Main St STREAM Branch - Mumford River

Wallis Reservoir

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mumford River Reservoir Assn. Place Douglas Use Storage reservoir

Inspected by W.O.L. Date June 6 1963

Type of Dam Highway Embankment Condition Good

SPILLWAY

Flashboards in Place 2' of pinboards Recent Repairs _____

Condition Good

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition Good

Repairs Needed _____

GATES

Recent Repairs _____

Condition Good

Repairs Needed _____

LEAKS

How Serious There is a small leak at the gate

DATE: _____ County Engineer

Dam 13-07

gles

ve 6, 1963 WOL

ay - This 30'(±) long, stepped granite stone spillway, is located 25' below the small bridge on Northwest Main St. This spillway is on ledge foundation. 4 @ 36" pipes have been added to the bridge at the roadway. This spillway has 24" of pin boards.

A new additional spillway, on ledge and natural ground has been added on the southerly end of the original spillway. This new overflow spillway is 25' long. The crest elevation is the same as the old spillway. This spillway also has 2 boards @ 24" in height. The pins and pin boards have been recently renewed. The walkway and abutment walls are good.

ment-The highway embankment is good. The riprap on the upstream slope has been recently gunited with cement The pond is full to the top of the pin boards. This dam is about 25' high.

: - The gate doors are Some of the timbers are beginning to rot and should be replaced There is a small leak at the 2'x2' stone box gate outlet.

WN Douglas DAM NO. 13-07

CATION On Northwest Main St STREAM Branch - Mumford River

"Wallis Pond"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

ned by Mumford River Associates Place Whitinsville Use Storage reservoir

spected by FEP-WJL-Del Barnes Date Sept 2, 1954

pe of Dam Highway embankment Condition Fair

ILLWAY

ashboards in Place _____ Recent Repairs _____

ndition Good

pairs Needed _____

BANKMENT

cent Repairs _____

ndition Good

pairs Needed This dam is quite weak, needs to be watched

TES

cent Repairs _____

ndition Good Recent work at top of dam

pairs Needed being done by the owners

This dam is now open

AKS

w Serious No leaks are visible

TE: _____ County Engineer

WN Douglas DAM NO. 13-07

CATION Northwest Main St. STREAM Branch - Mumford River

"Wallis Reservoir"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Mumford River Reservoir Assn.

ned by Whitins Machine Works Place Whitinsville Use Storage Reservoir

spected by W.O.C - D. Barnes Date Aug. 17, 1965

pe of Dam Highway embankment Condition Good

ILLWAY

ashboards in Place _____ Recent Repairs _____

ndition Good

pairs Needed _____

BANKMENT

cent Repairs _____

ndition Good

pairs Needed _____

TES

cent Repairs _____

ndition Repairs were recently done to this gate structure

pairs Needed - new steel grating was installed.

AKS

w Serious No leaks

TE: _____ County Engineer

:ION REPORT & DATA FOR DAMS

Dam No. 13-07
Town: Douglas
Stream: Branch of Mumford River
Pond: Wallis Reservoir
Date:
By:

CONDITION RATING
Structural:
Hydraulic:
General:
PRIORITY:

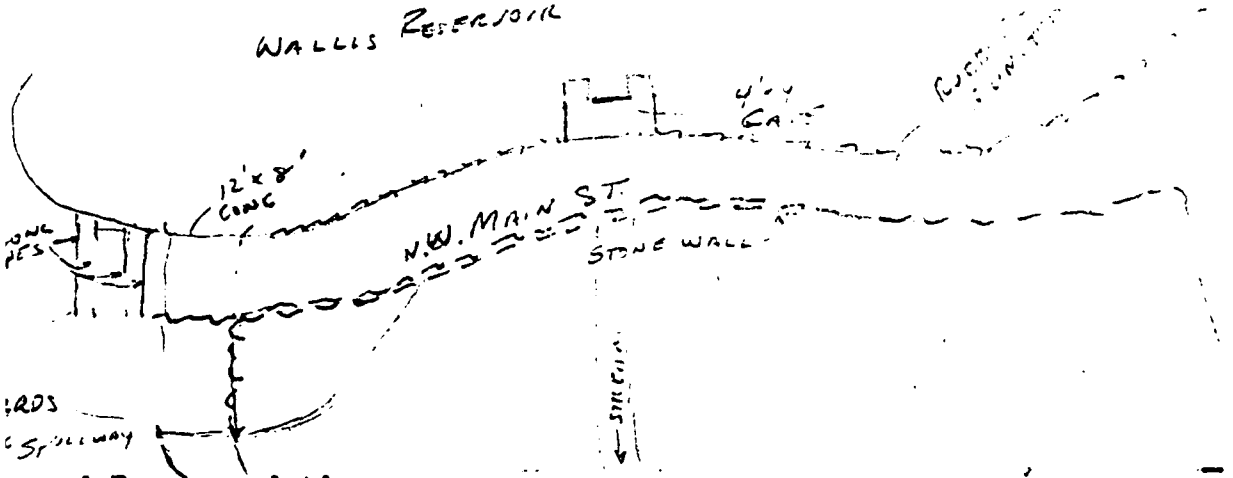
Mumford River Res. Assn. % Whitin Machine Works
ress: Main St., Whitinsville
n of Dam: Storage Reservoir

n & Access: South of Birch St.-West St. Intersection
n Northwest Main St.
iad. Oxford 21D Lat. 42°04'45" Long. 71°45'30"
.r.: Sq.Mi.; Ponds: ac.; Res.@dam:
:er of D.A.:

:ed
:ge
:y:

. Description of Dam and Discharge Control: EARTH DAM - STONE [illegible] SIDES ON N.W. MAIN ST. RESERVOIR FACE GUNITE. CONTROL BY [illegible] GATE

(Not to Scale):



s and Recommendations:

1/2/71 By A.R.T. Comment
P.R

Dam No. 3-14-77-07

the flash boards has been lower !, making it safer. There is one portion am southerly of the spillway between the spillway and Douglas Road which e have bulged and at present there seems to be no apparent leakage, but t might be advantageous to have this investigated and either install s or put fill behind this area to give the dam more body.

third dam is located to the easterly side of Castle Hill Road and is a nite dam. Both this and the Power House Dam probably have some type of it least puddled clay, but there are no plans to my knowledge to show the construction. This latter dam we call the Whitin Estate Pond Dam. It .l dam which was on a former Whitin estate and backs up a small body of roximately 8' in depth. This dam has a gate structure which, to my knows never been used. It has an overflow and after the '55 flood had a verflow installed wider than the original and 3" higher than the normal to function only in case of flood. This dam has no value to the plant n an aesthetic value. Since the company turned over the larger body of stream known as Riley's Pond, it is of no value to the plant operation.

e fourth dam known as Lackey Dam is owned by [illegible]any. It is an old nd wood log dam with granite block sid[illegible] end and a dual gate e operated with rack and pinio[illegible] illway is 66' and carries two permanent f[illegible] pillway. The gate s was rebuilt in [illegible] od. The log timber re in su[illegible] e a major repair end up [illegible] the dam was re- over the [illegible] blanket of clay. to cut do[illegible] irons and flash- pports an[illegible] settling - the log c[illegible] ure end is about f level at [illegible] is planning to re- e triple st[illegible]er. I don't know if their clude any c[illegible] probably not. This dam backs up f water appr[illegible] than the Power House Dam and has no partilue for the [illegible] plant operation except the fact the gate can be f you need wa[illegible] in a hurry. (I should have mentioned that since the ille Water Company built the dam at the point where the Meadow Pond and River join, that the body of water behind the Power House Dam is cut down considerably and is about 12' deep at the dam.) Each gate is approximately in the waste gate structure in Lackey Dam.

EXCERPT OF LETTER From: DELWYN BARNES TO: JOSEPH ROSOL

WHITIN RESERVOIR

e next dam that the company is involved in is on the head waters of the River known as the Mumford River Reservoir. This dam is a granite block granite block walls for guard rails on top, as the dam is crossed by the hway. This dam also has a bridge under the highway between the lake side lam and the spillway. The spillway is approximately 36' in width, carryf removable flash boards. This flash board structure was just rebuilt in t also has an unrestricted spillway without flash boards which is approxihe same width and height. Both spillways overflow the water onto a ledge which runs all the way to the discharge stream below the dam. The has a gate structure in the center with a 2' square gate operated on a screw with a large nut. This structure, formerly of wood, was all reith steel after the '55 flood. The bridge seemed to be a bottleneck he '55 flood so three large concrete culverts were installed through way southerly of the bridge. This dam is owned by the Mumford River r Company of which the company's share is 10/16. The dam and some land e dam and along the discharge brook and some land adjacent to the Reservoir

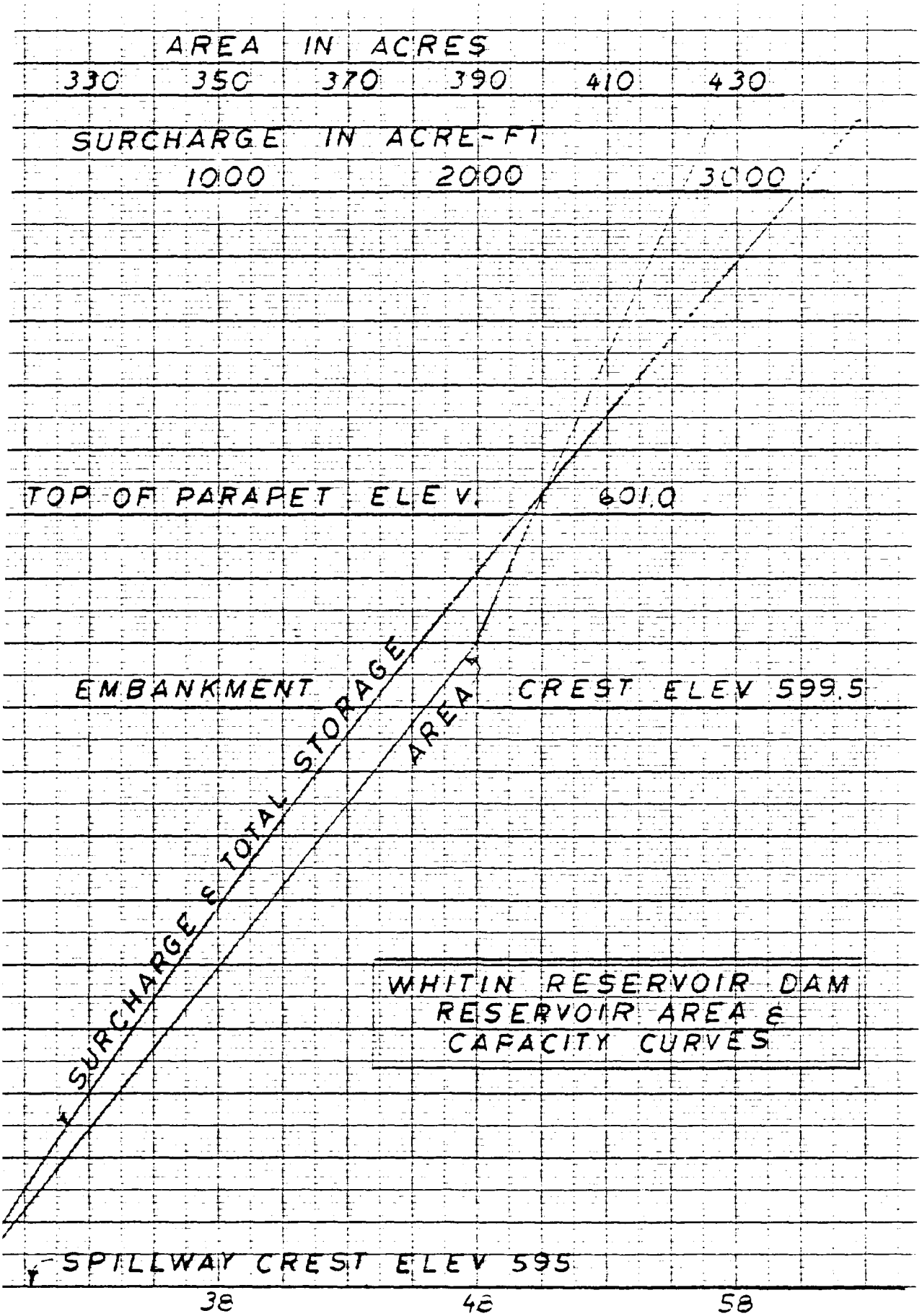
end of the Reservoir are owned, I believe, by ATF/Davidson. Any dimen- than what I have given you, with the exception of the depth of water ' at full pond, I would have to obtain for you. The Mumford River as a causeway which cuts the Reservoir roughly in half. This cause- some study, was proven to belong to the town and at that time the aired the culvert which joins the two bodies together and installed ard rails on the culvert. The town maintains the roadways on the dam causeway. The dam has been fenced on the down stream face with a fence and the gate structure and overflow structure have also been

ast and final dam is the Manchaug Reservoir Corporation Dam which is made up of two mills - ATF/Davidson owning 5/6. The Manchaug Reservoir one block dam as Mumford, and has a gate structure with a 2' square same type of operation with a vertical screw and nut. The spillway gh the top of the dam and has removable flash boards. The spillway is h and is practically 10' high and carries flash boards 40" high. This lly had granite block guard rails, but after the '55 flood the Massa- partment of Public Works, Division of Waterways, made a study of the id Dam which is just down stream from the Manchaug Dam and was damaged flood. They decided to spend considerable money on the Manchaug Res- so that it would act as a flood control dam and would thus protect the id Dam instead of spending a large amount of money on the Stevens Pond near as beneficial results. To do this they raised the dam's height reinforced the dam by adding a long slop embankment to the back side . The town highway also crosses this dam. At the same time, the State spillway and the bridge over the spillway and carried the spillway back toe of the dam and covered this spillway to this point where it into the stream. This is the same stream which the gate structure dis- to. The gate structure and the spillway structure have also been changed cel and fenced in by the Reservoir Company. The front face of the the original granite block wall is rip rap. The highway crossing the ntained by the town and has concrete and cable guard rails - also the town.

New Ring Shop Dam, the Power House Dam and the Whitin Estate Pond Dam ated in the Town of Northbridge. Lackey Dam and Manchaug Dam are the Town of Sutton and the Mumford River Reservoir Dam is located in f Douglas. Portions of Lackey Pond are in Sutton and Uxbridge and f Manchaug Pond are in Sutton and Douglas. Portions of the Mumford ed up by the Power House Dam are in Northbridge and Sutton. The other Northbridge.

dams have been well maintained yearly, keeping all brush and grass doing all necessary pointing and masonry, repairing structures, etc. ry. The annual inspection used to be done by the Worcestery County It is now handled by the State of Massachusetts. We have always imented on the maintenance of all these dams. They were viewed in 1974 by Mr. Les McLean of the Travellers' Insurance Company. He n again in 1977. The dams are now supervised and regulated by the le Water Company who inspects and maintains the structures on an is with visits to the dams as necessary, depending on weather condi- metimes during critical periods these inspections are oftener than once

Manchaug Dam was built in 1836 and revamped in 1960 and the Mumford River ilt in 1854. The Lackey Dam, I imagine, was built around the time of



WHITIN RESERVOIR DAM
RESERVOIR AREA & CAPACITY CURVES

D-3

Volume Estimate for Sediment Storage Capacity

Vol = 1/3 HA = 1/3 (285)(315) = 2990 A-F

From old reservoir sheet Vol = 3000 A-F

Say New Storage = 2800 A-F

Elev.	Area Acres	Ave Area	ΔH Ft	Δ Vol	Total Volume	Subtotal Volume
595	315				2990	
596	331.6	323.3	1	323	3313	323
597	348.2	339.9	1	340	3462	472
598	364.8	356.5	1	357	3820	830
599	381.4	373.1	1	373	4193	1203
600	398	389.7	1	390	4583	1593
601	406	402	1	402	4985	1995
602	414	410	1	410	5395	2405
603	422	418	1	418	5813	2823
604	430	426	1	426	6239	3249
605	438	434	1	434	6673	3683

DATE 3-[illegible] 80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF 1

BY ____ DATE ____ INSPECT DAM [illegible] PROJECT [illegible]

CT ____ [illegible] YORK, N.H.

[illegible] AREA: MAP SCALE 1" = 200'

AREA #1 READ #2 90.76 READ #3 123.28
" #1 58.38 " #2 90.76
32.38 32.52 AVE = 32.5'

AREA #2 READ #2 69.74 READ #3 99.45
" #1 40.00 " #2 69.74
29.74 29.71 AVE = 29.7'

DRAIN AREA = 62.24(.1437) = 8.95 SQ. MI. = 5716 AC.

RECREATION AREA ELEV 590'

READ #2 29.00 READ #3 32.43
" #1 25.57 " #2 29.00
3.43 3.43

RECREATION AREA = 3.43(91.88) = 315 ACRES

AREA ELEV 600

READ #2 36.65 READ #3 40.96
" #1 32.30 " #2 36.65
4.35 4.31

AREA ELEV 600 = 4.33(91.88) = 398 ACRES

AREA ELEV 610

READ #2 46.57 READ #3 51.76
" #1 41.38 " #2 46.57
5.19 5.19

AREA @ ELEV 610 = 5.19(91.88) = 477 ACRES

Appendix D

Hydrologic and Hydraulic Computations

13. Downstream spillway discharge channel

11. Roadway bridge over spillway approach channel

12. Footbridge over spillway crest

9. Gate structure on upstream face of dam

10. Low level outlet at base of downstream face of dam.

7. Seepage at base of downstream rubble masonry wall about 20 ft. left of the low level outlet

8. Seepage at base of downstream rubble masonry wall about 2 ft. left of the low level outlet

5. Downstream rubble masonry face

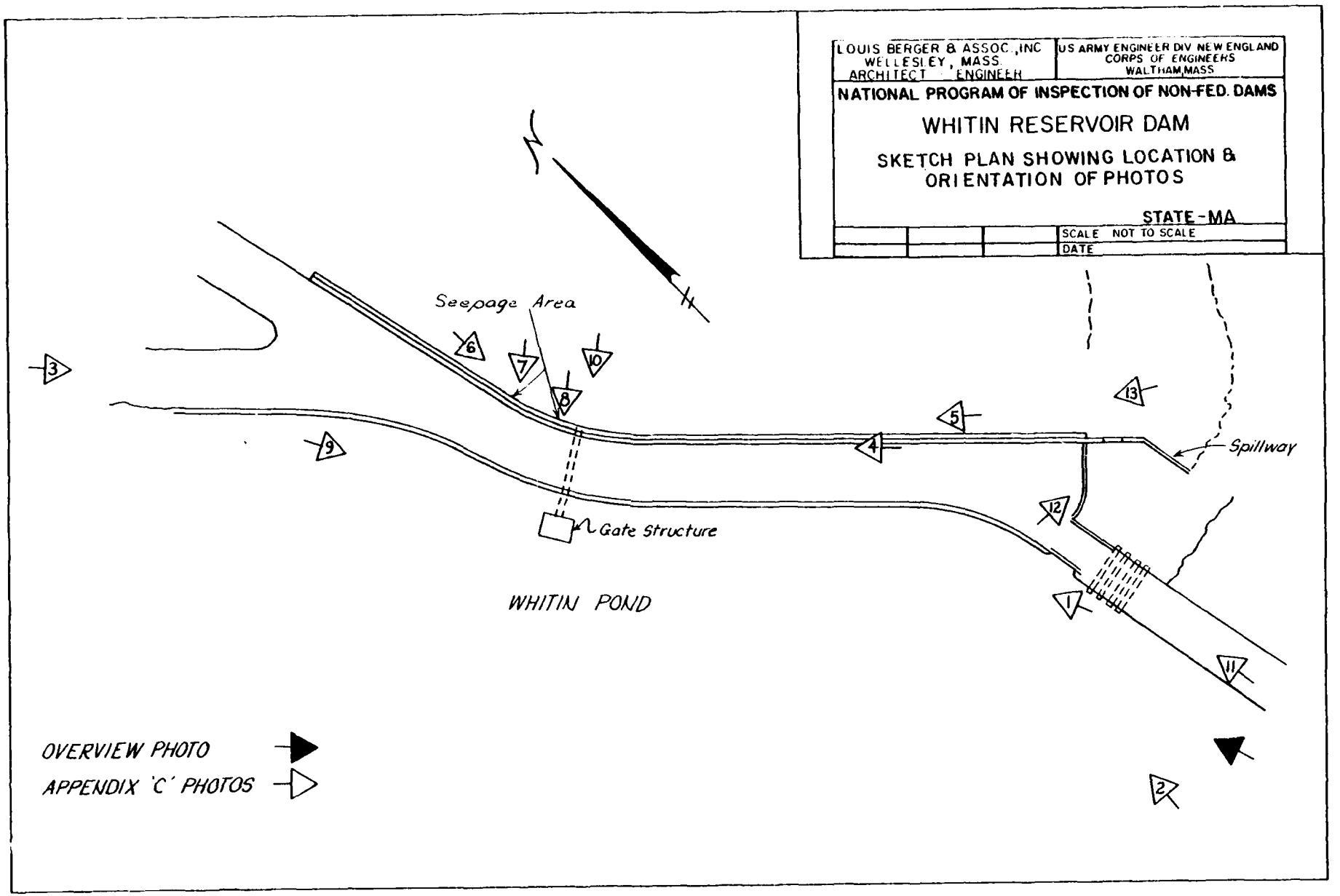
6. Downstream rubble masonry face

3. View along crest of dam

4. Crest of dam and downstream face

1. Upstream face of dam

2. Stone riprap on upstream slope of dam
(photo taken by others)


LOUIS BERGER & ASSOC., INC
WELLESLEY, MASS.
ARCHITECT ENGINEER
US ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
WHITIN RESERVOIR DAM
SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS
STATE - MA
SCALE NOT TO SCALE
DATE
Seepage Area
Spillway
Gate Structure
WHITIN POND
OVERVIEW PHOTO
APPENDIX 'C' PHOTOS
1
2
3
4
5
6
7
8
9
10
11
12
13

Appendix C

Photographs

the Power House Dam. These dams have gone through several critical floods, particularly the flood of 1955 when we had 13.69 inches of rain basically over a three-day period with 10 inches coming in one day.

These structures that are not enclosed in the plant area, are all posted for trespassing, and we have very good cooperation with the police forces in the three towns and have very few problems with vandalism.

The Mumford and Manchaug Dams (as well as the Carpenter Reservoir Dam which was a power dam and sold to the Whitinsville Water Company) were built to store water to make sure that the different companies owning shares would have a constant supply of water to operate throughout the year. The amount of water to be drawn was all restricted. This practice is still followed, except that now that the mills are not as many and are not wholly dependent on water power and since there are more campers around the reservoirs, we try to favor the campers during camping season.

The land under the reservoirs was acquired for flowage rights and are not directly owned, but the dams and other areas mentioned are owned direct.

If there is any further information you might wish to have, I'll be glad to try to obtain it for you.

Very truly yours,

Delwyn H. Holmes
Vice President

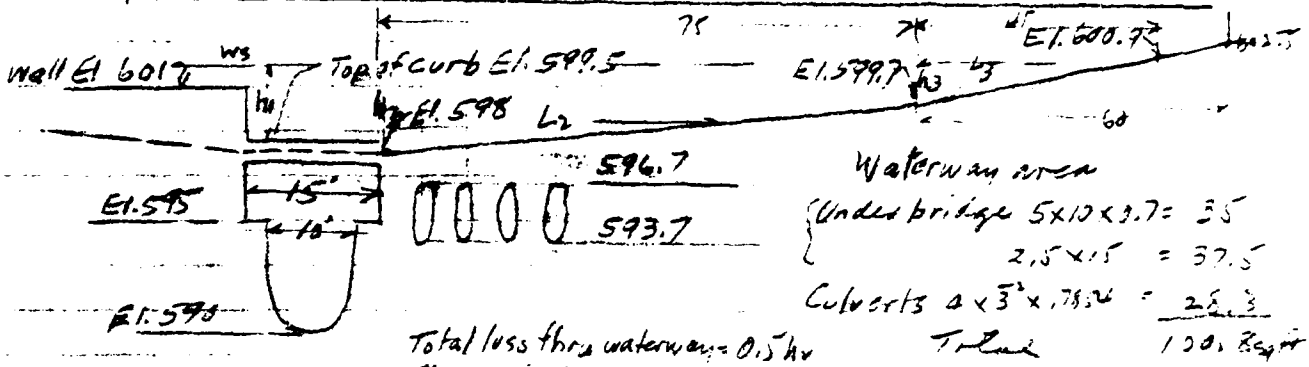
DHH:spp

BY CSH DATE ____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF 2

CHKD. BY ____ DATE ____ INSPECTION OF DAMS - MASS PROJECT W-196

SUBJECT WHITIN RESERVOIR DAM - SPILLWAY DISCHARGE CURVE

SPILLWAY DISCHARGE - CONTROL AT BRIDGE AND CULVERTS



Waterway area

Under bridge $5 \times 10 \times 3.7 = 35$

$2.5 \times 15 = 37.5$

Culverts $4 \times 3^2 \times .78.54 = 25.3$

Total 100.3 Sq ft

Total loss thru waterway = $0.5 h_v$

Flow over dam uses $C = 3.0$

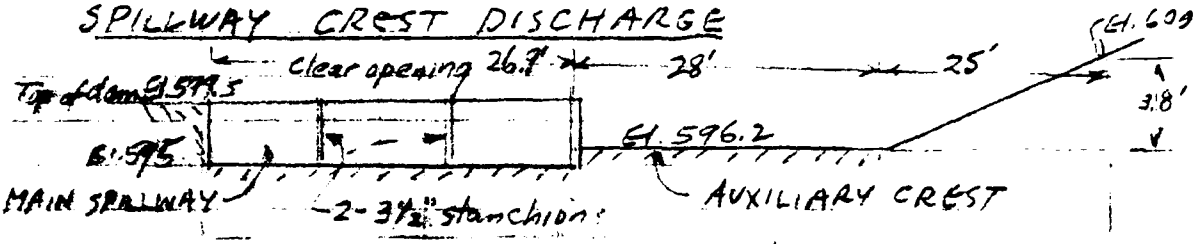
Trial Q / Q_w	V	h_v	$1.5 h_v$	upstr. water surf.	h_1	$q_1 = Cb_1 h_1$	ΔQ_1 L=15	h_2	q_2	h_3	q_3	$\frac{q_2+q_3}{2}$	L_2	ΔQ_2	$\frac{h_3}{2}$	L_3	ΔQ_3	ΣQ
Downstr. W.S El. 598.0 Total Q = 665 cfs																		
600	5.95	0.55	0.83	598.83	0.33	0.57	9	0.83	2.27	0	0	1.13	36.6	41	0	0	0	650
615	6.10	0.58	0.87	598.87	0.37	0.68	10	0.87	2.43	0	0	1.22	38.4	47	0	0	0	672
Downstr. WS. El. 599 Total Q = 1180 cfs																		
700	6.94	0.75	1.12	600.12	1.62	6.19	93	2.12	9.26	0.42	0.82	5.04	75	378	0.41	15.8	6	1177
Downstream WS. El. 599.5 Total Q = 1470 cfs																		
700	6.94	0.75	1.12	600.62	2.12	9.26	139	2.62	12.72	0.92	2.65	7.69	75	576	1.33	34.5	46	1461
Downstream WS. El. 600 Q = 1832 cfs.																		
700	6.94	0.75	1.12	601.12	2.62	9.77	191	3.12	16.53	1.42	5.08	10.80	75	810	2.50	53.3	133	1834
Downstream WS. El. 601 Q = 2608																		
700	6.94	0.75	1.12	602.12	3.62	20.66	310	4.12	25.89	2.42	11.29	18.19	75	1364	5.65	60	339	2713
675**	6.70	0.70	1.04	602.04	3.54	19.98	300	4.04	24.36	2.34	10.74	17.54	75	1316	5.37	60	322	2613
Downstream WS. El. 602 Q = 3517																		
650	6.45	0.65	0.97	602.97	4.47	28.35	425	4.97	33.24	3.27	17.74	25.49	75	1912	8.37	60	502	3549
Downstream WS El. 603 Q = 4561																		
600	5.95	0.55	0.83	603.83	5.33	36.97	554	5.83	42.23	4.13	25.18	33.71	75	2528	14.89	60	893	4575

BY _____ DATE _____ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF 2

CHKD. BY _____ DATE _____ INSPECTION OF DAMS - MASS. PROJECT W-198

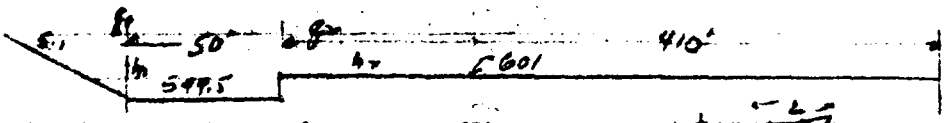
SUBJECT WHITIN RESERVOIR DAM - SPILLWAY DISCHARGE CURVE

SPILLWAY CREST DISCHARGE

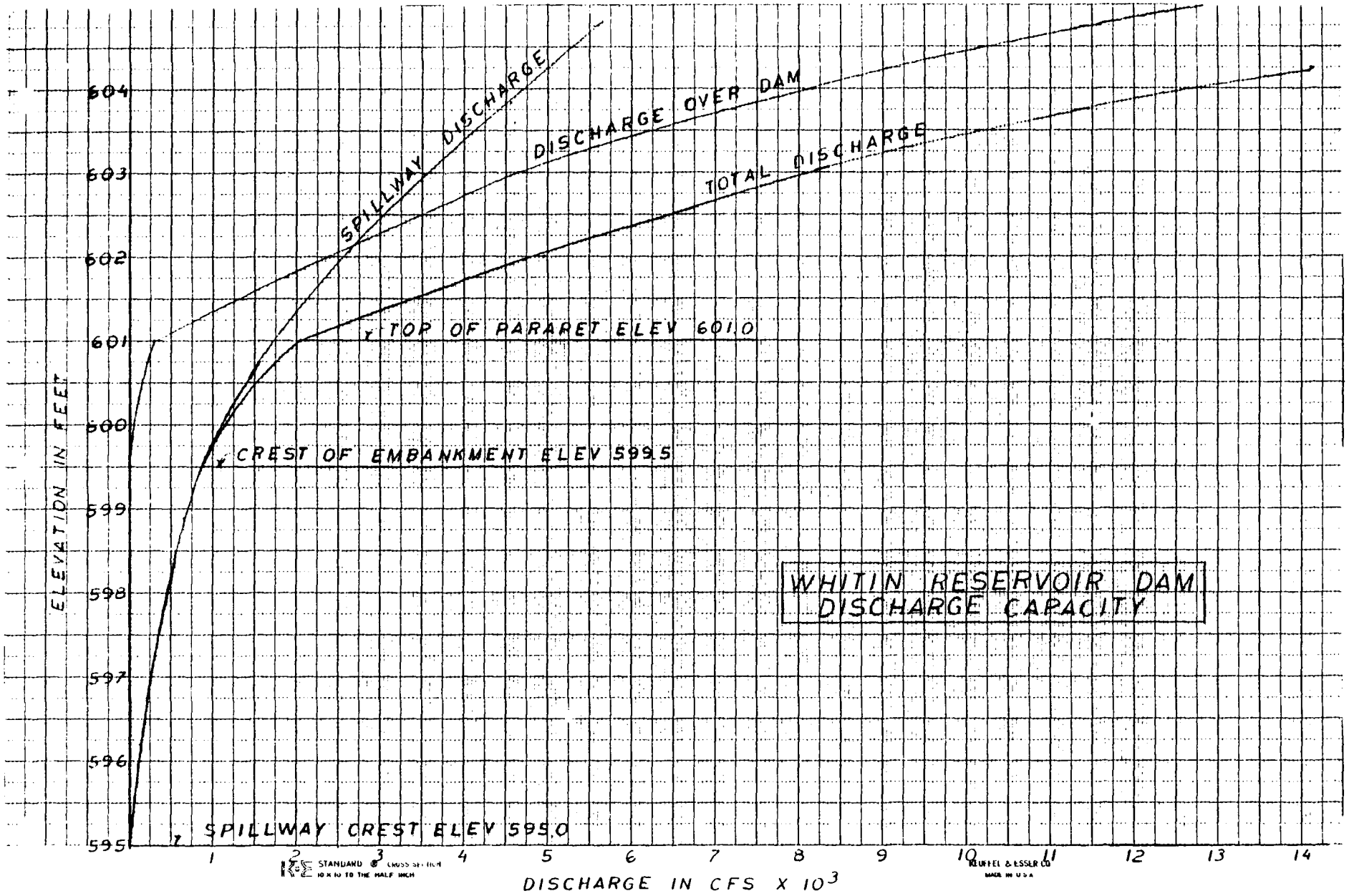


	MAIN SPILLWAY L = 26.7'			AUXILIARY CREST L = 28'								
ELEV.	H	C	ΔQ	H	q	$q^{3/2}$	ΔQ	Ave. q	L	ΔQ	ΣQ	
595	-	-	0				0			0	0	
596.2	1.2	3.0	106	0			0	0		0	106	596.22
597	2.0	3.0	228	0.8	2.9	2.08	58	1.04	5.3	6	292	597.22
598	3.0	3.03	424	1.8	2.95	7.12	199	3.56	11.8	42	665	
599	4.0	3.06	659	2.8	3.0	14.06	394	7.03	18.4	129	1180	
599.5	4.5	3.08	772	3.3	3.0	17.98	503	8.99	21.7	195	1470	
600	5.0	3.1	932	3.8	3.0	22.22	622	11.11	25.0	278	1832	
601	6.0	3.1	1226	4.8	3.0	31.55	883	15.78	31.6	499	2608	
602	7.0	3.1	1544	5.8	3.0	41.90	1173	20.95	38.2	806	3517	
603	8.0	3.1	1887	6.8	3.0	53.12	1487	26.56	44.7	1187	4561	

DISCHARGE OVER DAM



Elev	h_1	$C=3.0$ q_1	h_2	$C=3.0$ q_2	ΔQ L=410	ΔQ L=50	q_{ave}	L	ΔQ	ΣQ
599.5	0	0				0	0	0	0	0
600	0.5	1.06	0			53	0.53	2.5	1	54
601	1.5	5.51	0	0	0	276	2.76	7.5	21	297
602	2.5	11.86	1.0	3.06	1230	593	5.93	12.5	74	2384
603	3.5	19.64	2.0	8.48	3477	982	9.82	17.5	172	4631
604	4.5	28.64	3.0	15.59	6392	1432	14.32	22.5	322	8146
605	5.5	38.7	4.0	24	9840	1935	19.35	27.5	532	12310


SPILLWAY DISCHARGE
DISCHARGE OVER DAM
TOTAL DISCHARGE
TOP OF PARARET ELEV 601.0
CREST OF EMBANKMENT ELEV 599.5
SPILLWAY CREST ELEV 595.0
ELEVATION IN FEET
604
603
602
601
600
599
598
597
596
595
1
2
3
4
5
6
7
8
9
10
11
12
13
14
DISCHARGE IN CFS X 10³
WHITIN RESERVOIR DAM
DISCHARGE CAPACITY
KEUFFEL & ESSER CO
MADE IN U.S.A.

BY R.F.B. DATE 4-1-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF 2

CHKD. BY ____ DATE ____ INSPECTION OF DAMS PROJECT NO. 28

SUBJECT WHITEN RESERVOIR DAM, PROVIDENCE, RI

DRAINAGE AREA (TOTAL) = 3.93 SQ MI

BY INSPECTION RESERVOIR ARE < 25% D.A.

LENGTH LONGEST WATER COURSE, L = 24,800 FT = 4.7 MI

ELEV DIFFERENCE = 890 - 595 = 295 FT

$\therefore$ SLOPE = $\frac{295}{4.70}$ = 62.77 FT/MI & $\sqrt{S}$ = 7.92

Now $\left(\frac{L \cdot L_c}{\sqrt{S}}\right)^{.33} = \left[\frac{4.7 \times 4.7}{7.92(2)}\right]^{.33} = 1.12$

LAG = $K\left(\frac{L \cdot L_c}{\sqrt{S}}\right)^{.33} = 1.12K$

ASSUME K = 5.0 HRS — REFER TO "CURVE B" MOUNTAINOUS REGION, MIXED TERRAIN, B SOIL GEL

LAG = 1.12 (5) = 5.6 HRS

T_p = 0.41D + .92 LAG, WHERE D = 1.0 HR

T_p = 0.41(1) + .92(5.6)

T_p = 0.41 + 4.59 = 5.0 HRS

CHECK VELOCITY $\frac{T_c = T_p - 0.5D}{0.6}$

$T_c = \frac{5.0 - .5}{0.6} = 7.5$ HRS

$V = \frac{24,800}{(7.5)(3600)} = 0.91$ FT/SEC OK

$T_2 = 1.67\ T_c = 1.67\ (5.0) = 8.35$ hrs
$T_2 = T_p + T_c = 5.0 + 8.35 = 13.35$ hrs

$q_p = \frac{484\ A\ Q}{T_c}$, A = Drainage Area
Q = Runoff in inches

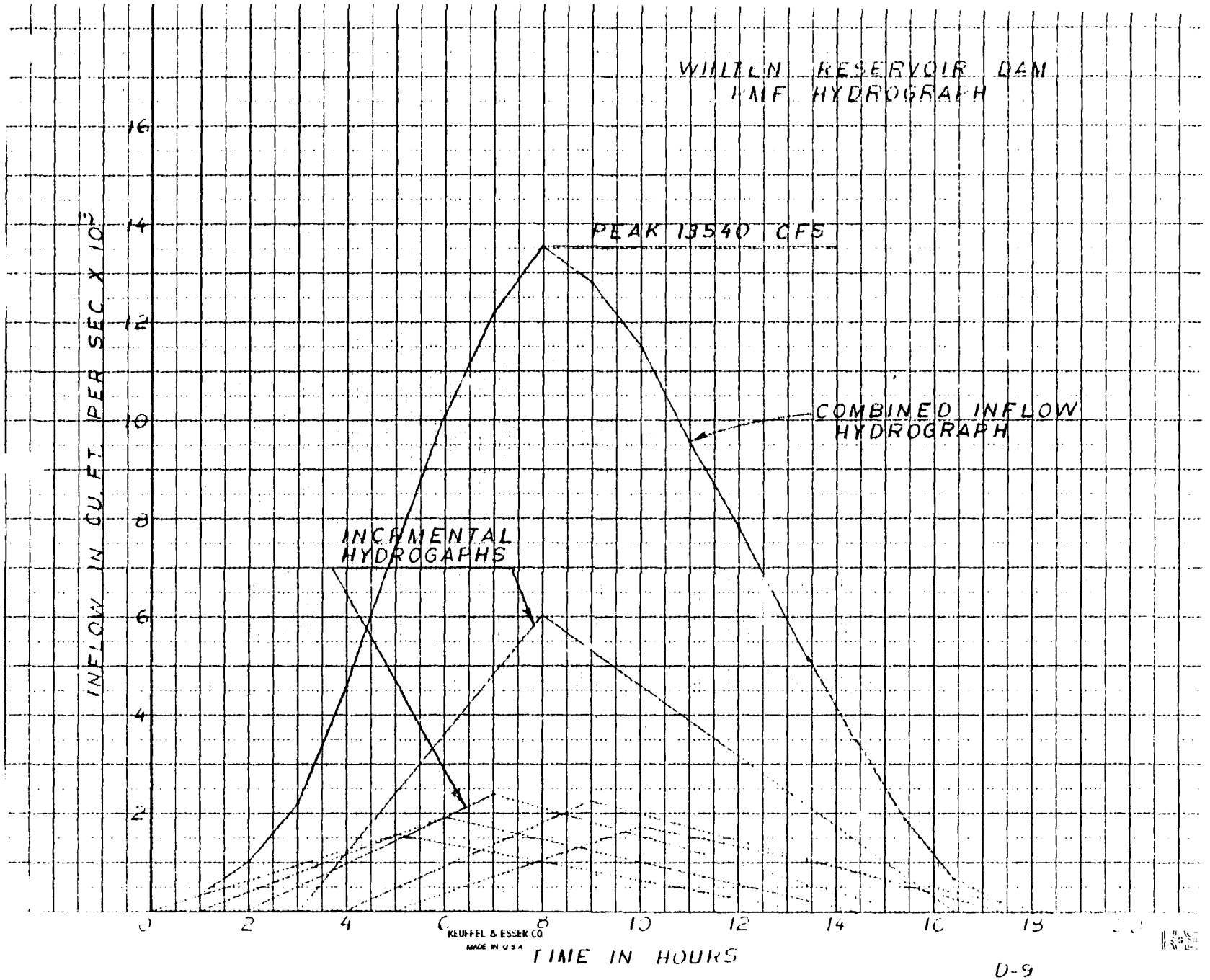
$q_p = \frac{484\ (8.93)(1)}{5.0} = 864$ cfs

PMF = 23.5 (.8) = 18.8" for Douglas, Maine
= 18.4" consistent with 1/2 of 1/2 of 1/2 of overland flow.

Flood Hydrograph for PMF $q_p = 864$

Time (hours)	Rainfall		Q_p cfs	Time		
	* %	inches		Begin	Peak	End
0.0						
1.0	10	1.84	1590	0	5.0	13.4
2.0	12	2.21	1909	1.0	6.0	14.1
3.0	15	2.76	2385	2.0	7.0	15.4
4.0	38	6.99	6039	3.0	8.0	16.4
5.0	14	2.58	2229	4.0	9.0	17.4
6.0	11	2.02	1745	5.0	10.0	18.4

* Distribution of Maximum 6 hour PMP in percent of 6 hour amount PMP
Engineering Manual


WHITE RESERVOIR DAM
PMF HYDROGRAPH
PEAK 13540 CFS
COMBINED INFLOW HYDROGRAPH
INCREMENTAL HYDROGAPHS
INFLOW IN CU.FT. PER SEC X 10³
TIME IN HOURS
0
2
4
6
8
10
12
14
16
KEUFFEL & ESSER CO
MADE IN U.S.A.

REB DATE 9-18-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF 6

IKD. BY DATE INSPECTION OF DAMS PROJECT W-198

BJECT WHITIN RESERVOIR DAM, RESERVOIR ROUTING

DRAINAGE AREA = 8.93 SQ MI = 5,716 ACRES

SIZE CLASSIFICATION - INTERMEDIATE

MAXIMUM STORAGE = 4,475 ACRE-FT.
HEIGHT = 33 FT

HAZARD CLASSIFICATION = HIGH

OCE GUIDELINES, USE FULL PMF

FROM INFLOW HYDROGRAPH, PMF = 13,540 CFS

STEP 1: Q_{P_1} = 13,540 CFS

STEP 2a: ELEV. = 604.13 FT

STEP 2b: SURCHARGE VOLUME = 3,480 ACRE-FT

$$\text{INCHES RUNOFF} = \frac{3,480 \text{ ACRE-FT}}{5716 \text{ ACRES}} \times 12 \text{ IN/FT} = 7.31 \text{ IN.}$$

STEP 2c: $Q_{P_2} = 13,540 \left(1 - \frac{7.31}{19}\right)$

$$Q_{P_2} = 8,230 \text{ CFS}$$

STEP 3a: FOR Q = 8,230 CFS

SURCHARGE HEIGHT = 603.05 FT

SURCHARGE VOL = 3030 A.F.

$$\text{INCHES OF RUNOFF} = \frac{3030}{5716} \times 12 \text{ IN} = 6.36 \text{ IN.}$$

STEP 3b

$$\text{AVE STORAGE} = \frac{6.36 + 7.31}{2} = 6.835$$

2ND ITERATION

STEP 2c $Q_{p2} = 13{,}540 \left(1 - \frac{6.835}{19}\right)$

$Q_{p2} = 8670$

STEP 3a FOR Q = 8,670 CFS

SURCHARGE HEIGHT = 603.15

SURCHARGE VOL = 3075 A.F

$$\text{INCHS RUNOFF} = \frac{3075 \times 12}{5716} = 6.455$$

$$\frac{\text{STOR}_1 + \text{STOR}_2}{2} = \frac{6.835 + 6.455}{2} = 6.645$$

3RD ITERATION

STEP 2c $Q_{p2} = 13{,}540 \left(1 - \frac{6.645}{19}\right)$

$Q_{p2} = 8806$

STEP 3a FOR Q = 8,806

SURCHARGE HEIGHT = 603.20

SURCHARGE VOLUME = 3,100 A.F.

$$\text{INCHS RUNOFF} = \frac{3100 \times 12}{5716} = 6.51 \text{ IN.}$$

$$\frac{\text{Stor 1} + \text{Stor 2}}{2} = \frac{6.645 + 6.31}{2} = 6.58$$

4th Iteration

Step 2c $Q_{p2} = 13,540\left(1 - \frac{6.58}{19}\right)$

$Q_{p2} = 8,850$

Step 3a For $Q = 8,850$

Surcharge Height = 603.25

" Volume = 3125

Incr Runoff = $\frac{3125 \times 12}{5716} = 6.56$

Step 3b $\overline{\text{Stor}} = \frac{6.58 + 6.56}{2} = 6.57$

Ave Surcharge Vol = $\frac{6.57 \times 5716}{12} = 3120$

" Surcharge Height = 603.23

$Q_{p3} = 9,000$ cfs

PMF Overtops Embankment crest by $603.23 - 599.5 = 3.73$ ft

Say H = 3.7 ft
Q = 9,000 cfs

TRY 1/2 PMF = 13,540/2 = 6,770 CFS

STEP 1: Q_{P1} = 6770 CFS

STEP 2a: ELEV. 602.60

STEP 2b: SURCHARGE VOLUME = 2,850 A.F.

INCHS RUNOFF = $\frac{2850 \text{ A.F} \times 12 \text{ IN/FT}}{5716 \text{ ACRES}}$ = 5.98 INCHS

STEP 2c $Q_{P2} = 6{,}770\left(1 - \frac{5.98}{9.5}\right)$

Q_{P2} = 2,508 CFS

STEP 3a FOR Q = 2,508

SURCHARGE HEIGHT = 601.15
" VOLUME = 2,250 AF

INCHS RUNOFF = $\frac{2{,}250 \times 12}{5716}$ = 4.73 IN

STEP 3b AVE STORAGE = $\frac{5.98+4.73}{2}$ = 5.355

2ND ITERATION

STEP 2c $Q_{P2} = 6{,}770\left(1 - \frac{5.355}{9.5}\right)$

Q_{P2} = 2950

STEP 3a FOR Q = 2,950

SURCHARGE HEIGHT = 601.32

SURFACE AREA = 2325 AF

INCHES RUNOFF = $\frac{2325 \times 12}{5716}$ = 4.88 IN

$\frac{\text{STOR 1} + \text{STOR 2}}{2} = \frac{5.37 + 4.88}{2} = 5.12$ IN

3RD ITERATION

STEP 2: $Q_{P2} = 6770\left(1 - \frac{5.12}{9.5}\right)$

$Q_{P2} = 3{,}120$

STEP 3: FOR Q = 3,120

SURCHARGE HEIGHT = 6.01.4

" VOLUME = 2350 AF

INCHES RUNOFF = $\frac{2350 \times 12}{5716}$ = 4.93 INCHES

$\frac{\text{STOR 1} + \text{STOR 2}}{2} = \frac{5.12 + 4.93}{2} = 5.02$

4TH ITERATION

STEP 2: $Q_{P2} = 6770\left(1 - \frac{5.02}{9.5}\right)$

$Q_{P2} = 3{,}100$

SURCHARGE HEIGHT = 6.01.2

" VOLUME = 2370

DATE 9-3-80 LOUIS BERGER & ASSOCIATES INC. SHEET NO. 4 OF 6

DATE INSERT ON SE PROJECT

[illegible] = $\frac{2270 \times 2}{57.6}$ = 1.99

STEP 3: $\overline{S_{TOT}} = \frac{5.02 + 5.18}{2} = 5.10$

AVE SURCHARGE VOL = $\frac{50 \times 6716}{12}$ = [illegible]

[illegible] = 60145

Q_{P3} = 3,500 CFS

PIT OVERTOPS EMBANKMENT BY 60145 - 57.6 = 1.45

SAY X = 1.9 FT

Q = 3,58[illegible]

DATE [illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. [illegible] OF 9

DATE [illegible] PROJECT [illegible]

[illegible]

STEP 1: [illegible]

STORAGE = 4475 AC-FT

HEIGHT = 33 FT

W = 30% OF 417 = 125 FT

STEP 2: PEAK FAILURE OUTFLOW

$$Q_{P_1} = 8/27\ W\sqrt{g}\ Y_o^{3/2}$$

$$Q_{P_1} = 1.68\,(125)(33)^{3/2}$$

$$Q_{P_1} = 39{,}800\ CFS$$

ADD SPILLWAY FLOW: $Q_{SPILLWAY} = 550$ CFS

$$Q_{P_1\ TOTAL} = 39{,}800 + 550 = 40{,}350$$

SAY $Q_{P_1} = 40{,}400$ CFS

STA 0+00 TO 54+00

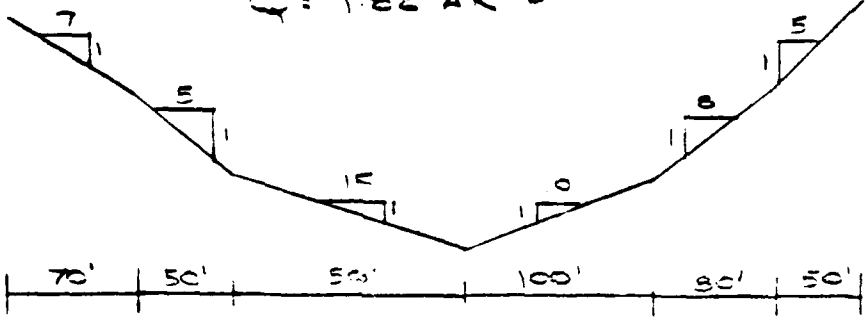
$$S = \frac{540 - 500}{5400} = .0122$$

$$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

$$S^{1/2} = 0.11$$

$$Q = 1.82\ AR^{2/3}$$

$n = 0.040$

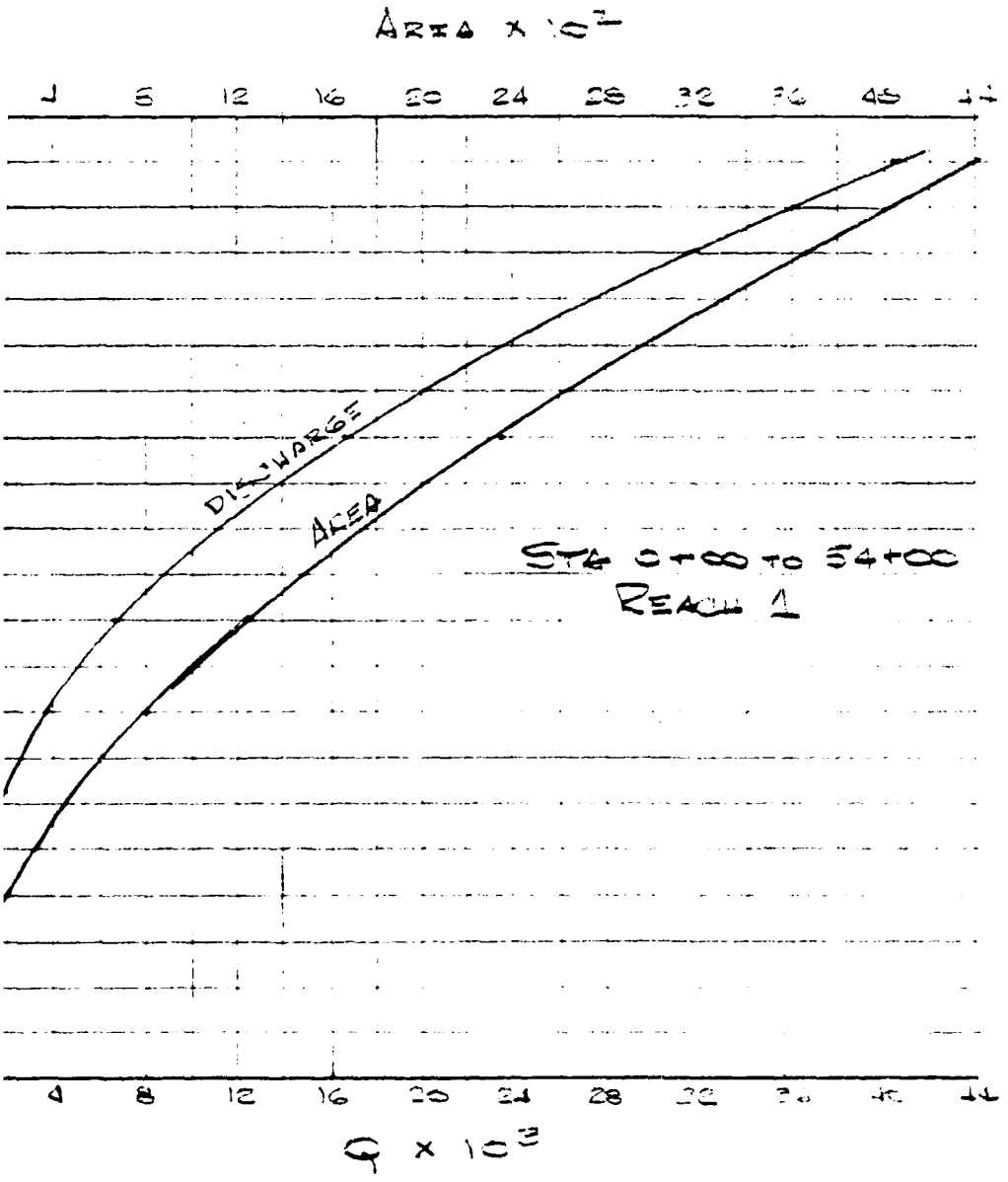


DATE 6-10-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF 2

DATE _____ INSPECTION OF DAMS PROJECT _____

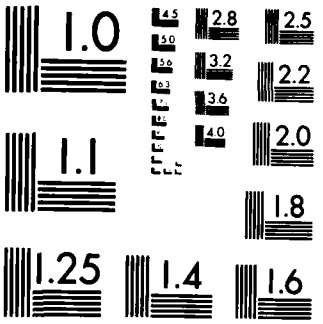
TIA RIBEIRO DAM - FAILURE ANALYSIS

AGE	AREA	P	R	$R^{2/3}$	Q
4	200	100.3	1.99	1.58	575
8	800	200.6	3.99	2.52	3670
10	1250	250.8	4.98	2.92	6643
14	2354	303.4	7.76	3.92	16794
18	3666	356.1	10.29	4.74	31625
22	4400	382.4	11.51	5.10	40,840



AD-A154 525 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
WHITIN RESERVOIR DAM..(U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV JUL 80

UNCLASSIFIED F/G 13/13 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

FOR C = 40,700 , STAGE = 20 FT , AREA = 4400 AC

$$V_1 = \frac{4400 \times 5400}{43,560} = 545 \text{ AC-FT}$$

$$Q_{P2}\ (\text{TRIAL}) = 40,700\left(1 - \frac{545}{4475}\right)$$

$$= 35,740 \text{ CFS}$$

FOR Q = 35,740, STAGE = 19 , AREA = 4000

$$V_2 = \frac{4000 \times 5400}{43,560} = 496 \text{ AC-FT}$$

$$V_{AVE} = \frac{545 + 496}{2} = 521 \text{ AC-FT}$$

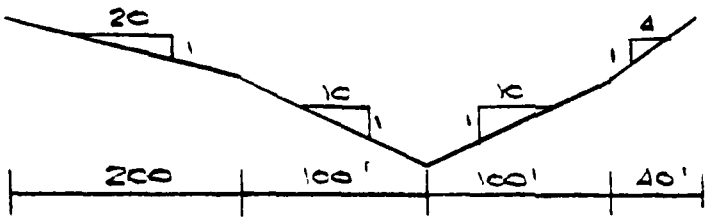
$$Q_{P2} = 40,700\left(1 - \frac{521}{4475}\right)$$

STA 54 + Q$_{P2}$ = 36,000, STAGE = 17 FT, ΔH = 14 FT

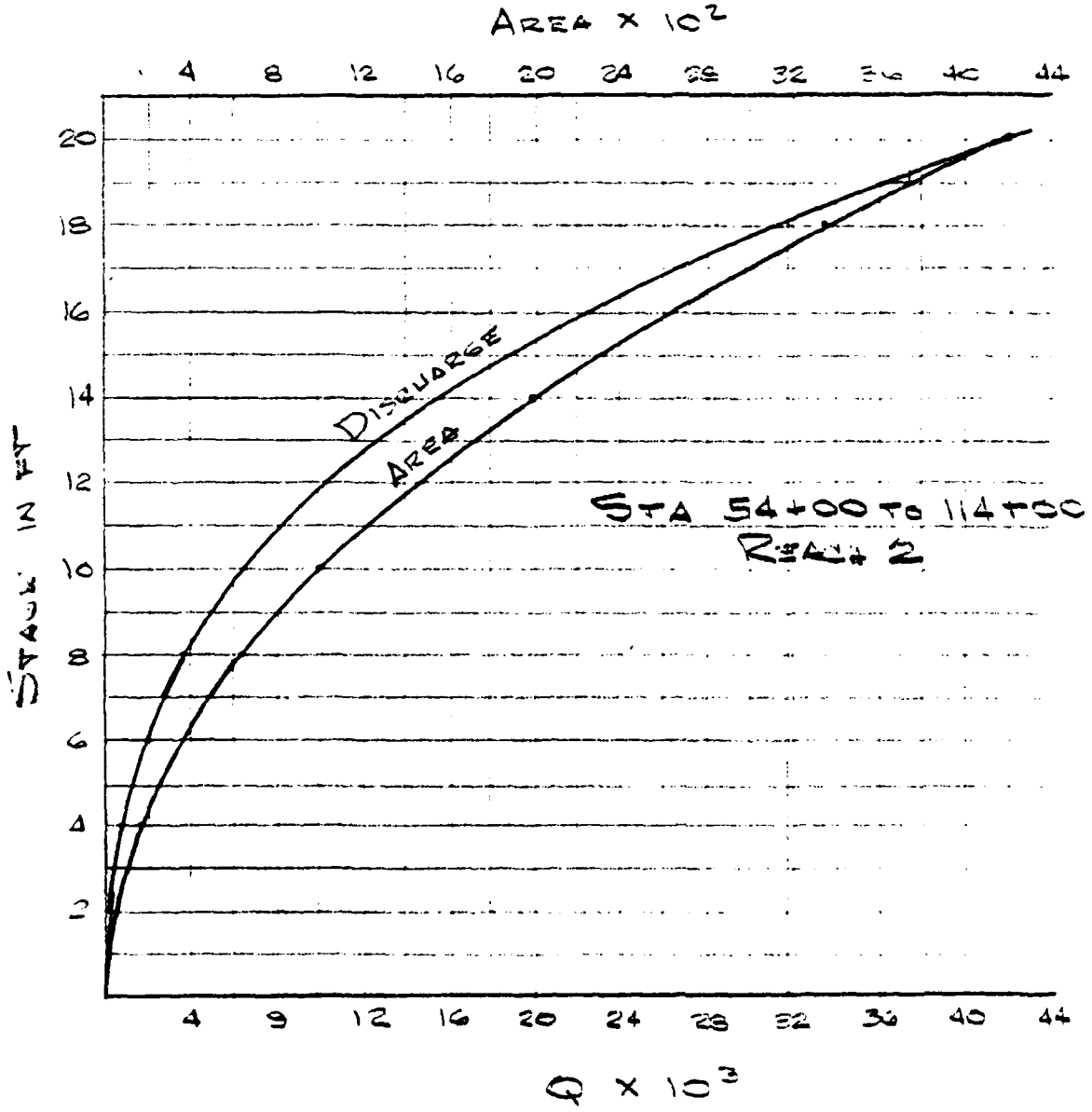
STA 54+00 TO STA 114+00 $\qquad S = \frac{360 - 240}{6000} = .015$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2} \qquad S^{1/2} = 0.1225$$

$$Q = 2.23 A R^{2/3} \qquad n = 0.040$$



STAGE	AREA	P	R	$R^{2/3}$	T
4	160	80.4	2.00	1.59	567
8	640	160.8	3.98	2.51	3582
10	1600	201.0	4.98	2.92	6511
14	1792	297.6	6.69	3.55	15,770
18	3368	394.2	8.54	4.18	31,394
20	4200	442.6	9.49	4.48	41,959



FOR Q = 36,000, STAGE = 190, AREA = 3750 ac

$$V_1 = \frac{3750 \times 6000}{43,560} = 516 \text{ Acre-ft}$$

$$Q_{P2}\,(\text{TRIAL}) = 36,000\left(1 - \frac{516}{4475}\right)$$

$$= 31,850 \text{ cfs}$$

FOR Q = 31,850, STAGE 188 FT, AREA = 3400 ac

$$V_1 = \frac{3400 \times 6000}{43,560} = 468 \text{ Acre-ft}$$

$$V_{AVE} = \frac{516 + 468}{2} = 492 \text{ Acre-ft}$$

$$Q_{P2} = 36,000\left(1 - \frac{492}{4475}\right) = 32,040$$

STA 114 Q = 32,000, H = 18.1, ΔH = 1.9 FT

STA 114+00 to 206+00

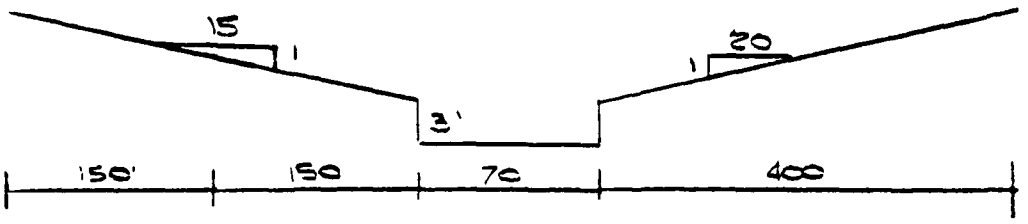
$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$S = \frac{340 - 270}{13,600} = .00147$$

$$S^{1/2} = .038$$

$$Q = 1.25\, A R^{2/3}$$

$$n = .045$$

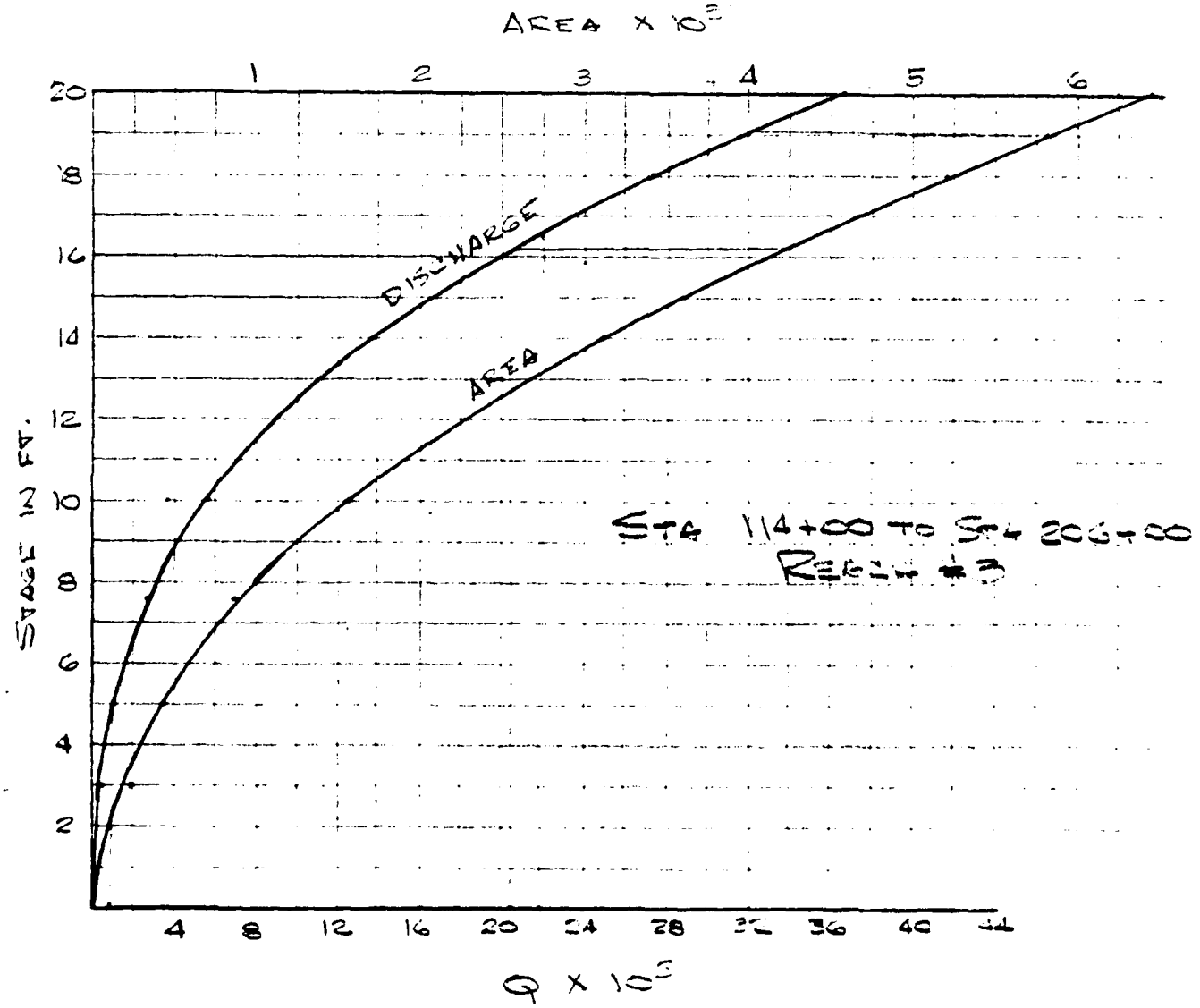


BY RER DATE 6-10-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 6 OF 7

CHKD. BY _____ DATE _____ INSPECTION OF DAMS PROJECT 4-108

SUBJECT WHITE ROCK LAKES DAM - BREACH ANALYSIS

STAGE	AREA	P	$R^{2/3}$	Q
3	210	76	1.96	514
5	420	146.1	2.62	1060
7.5	879	238.8	2.42	2659
10	1558	321.4	2.87	5589
14	3098	461.6	3.56	13786
18	5148	661.9	4.21	27,354
20	6455	672	4.52	36,457



FOR Q = 32,000, STAGE = 19 FT, AREA = 5800 AC

$$V_1 = \frac{(9200 + 3000)(5800)}{43{,}560} = 1624 \text{ ACRE-FT}$$

$$Q_{P2}\,(\text{TRIAL}) = 32{,}000\left(1 - \frac{1624}{4475}\right)$$

$$= 20{,}390 \text{ CFS}$$

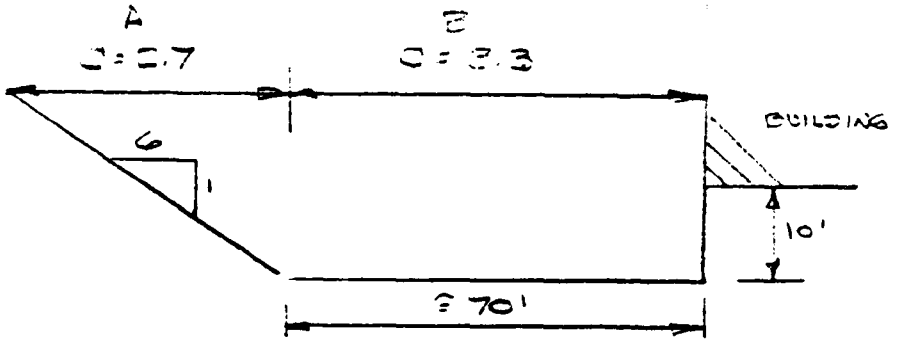
FOR Q = 20,400, STAGE = 16.2, AREA = 4250 AC

$$V_2 = \frac{(12{,}200)(4250)}{43{,}560} = 1190$$

$$V_{AVE} = \frac{1624 + 1190}{2} = 1407$$

$$Q_{P2} = 32{,}000\left(1 - \frac{1407}{4475}\right) = 21{,}928$$

STA 206, Q = 21,900, STAGE 16.5 FT, ΔH = 11.5 FT



DAM AT NR CHESTNUT TREE

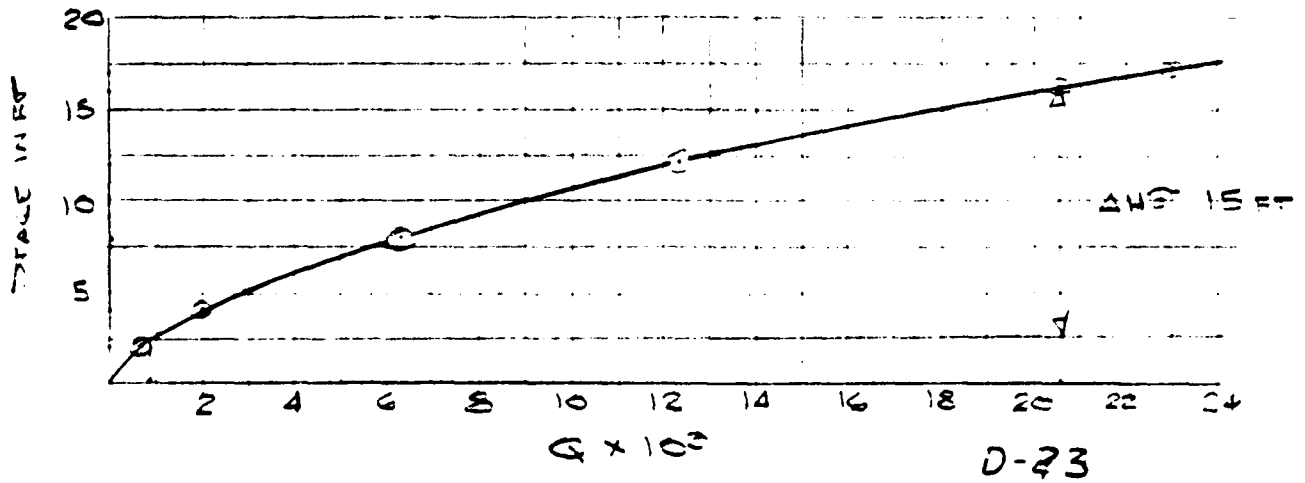
APPROXIMATE STORAGE FROM STA 256 TO DAM = 90 AF

SAY DISCHARGE AT DAM = $21{,}500\left(1-\frac{90}{3375}\right)$

Q = 21,500

B, C = 3.3 A, C = 2.7

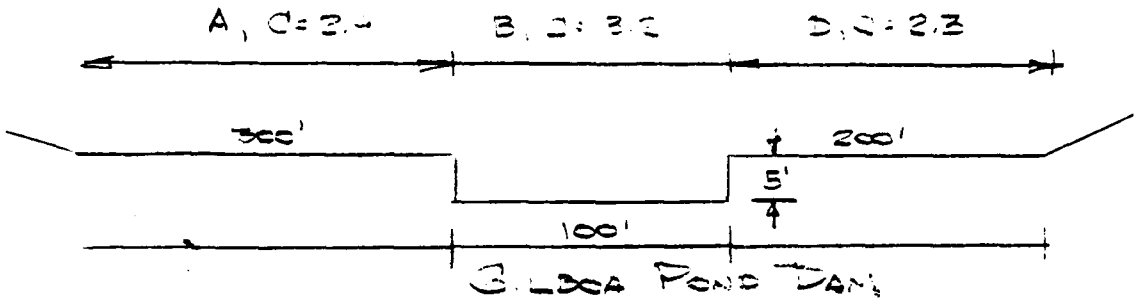
H	L	Q	H	L	Q	ΣQ
2	70	650	1	12	30	700
4		1850	2	24	180	2000
8		5230	4	48	1080	6300
12		9600	6	72	2860	12500
16		14790	8	96	5860	20600
17		16190	8.5	102	6820	23,000



BY RFB DATE 6-26-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 9 OF 9

CHKD. BY _____ DATE _____ INSPECTION OF DAMS PROJECT W-195

SUBJECT WHITIN RESERVOIR DAM EMBANKMENT ANALYSIS



GILDEA POND DAM

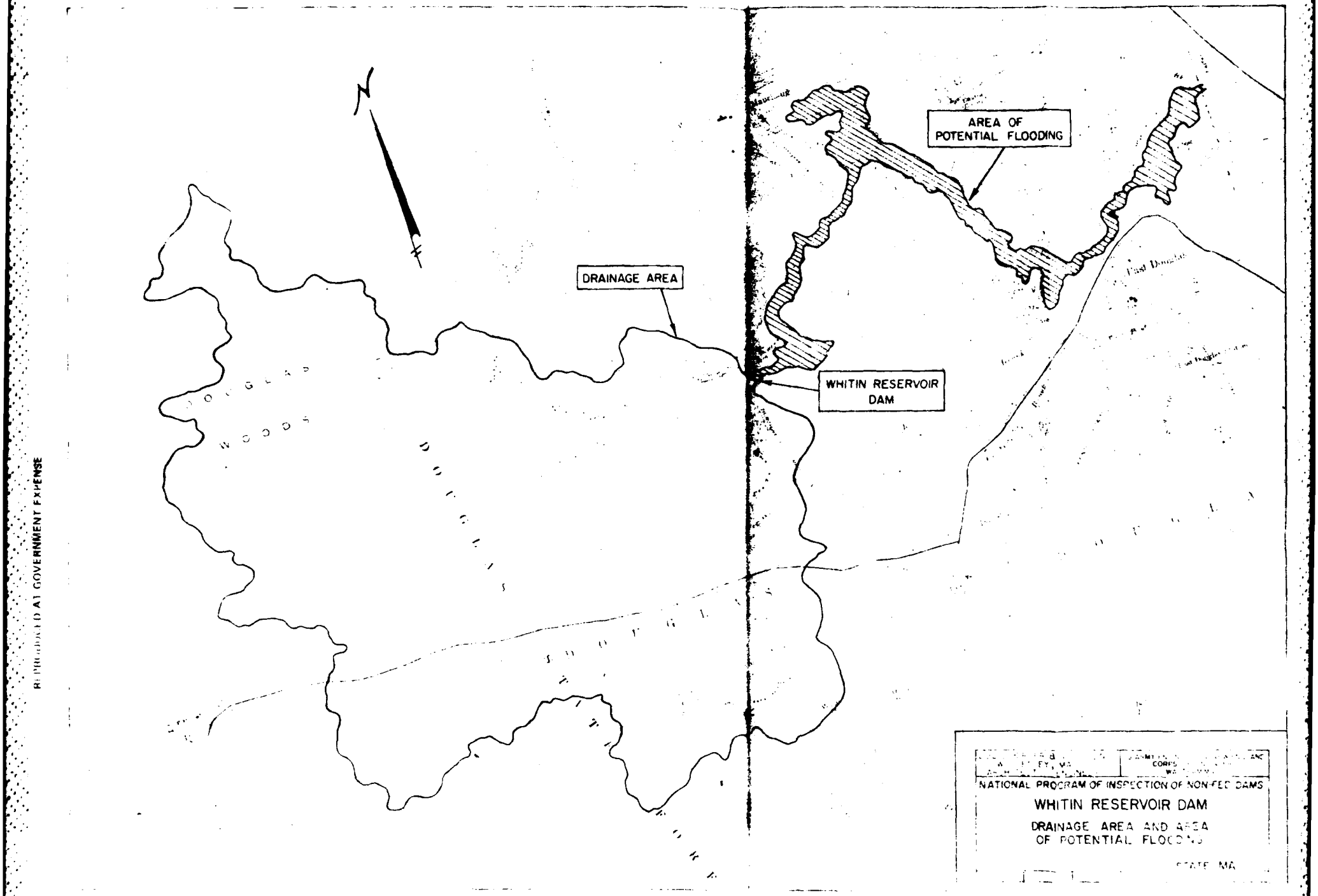
A, C=2.9			B, C=3.2			D, C=2.3			
H	L	Q	H	L	Q	H	L	Q	ΣQ
0	300	0	2	100	900	0	200	0	900
0		0	4		2050	0		0	2950
0		0	5		3520	0		0	3600
1		870	6		4700	1		460	6000
2		2460	7		5980	2		1360	7700
4		6960	9		8640	4		3700	14,300
5		9730	10		10,100	5		5110	24,900

ESTIMATE OF FLOODING

ABOUT 7 HOUSES AT EXTREME NORTHEND OF POND JUST UPSTREAM OF BRIDGE 1 TO 3 FT

INDUSTRIAL BUILDING ON NORTH SIDE OF ROAD 5 TO 6 FT

SEWAGE TREATMENT PLANT 3 TO 4 FT



Appendix E

Information as Contained in the National Inventory of Dams

END

FILMED

7-85

DTIC